The Plain Truth About the Harrisburg Improvements

Pure Water
Protection from Typhoid Fever
Modern Sewerage
Parks and Playgrounds

(*SECOND EDITION.*)

How to Obtain Them All at a Trifling Pro-rata Cost to Each Taxpayer

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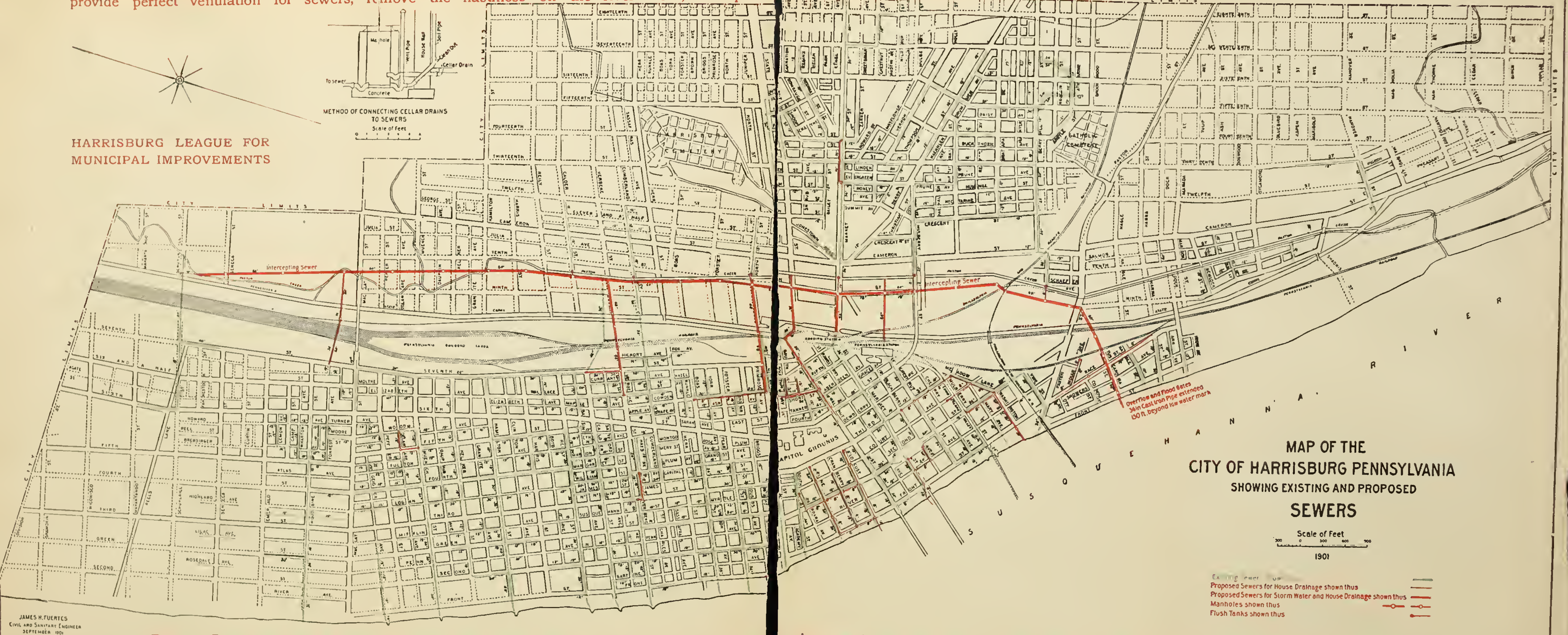
The proposed sewerage changes take care of the Paxton Creek nuisance and flood dange medy existing difficulties with old sewers,
provide perfect ventilation for sewers, remove the nastiness on the river front, and preve e malaria and mosquitoes of low water.



MAP OF THE
CITY OF HARRISBURG PENNSYLVANIA
SHOWING EXISTING AND PROPOSED
SEWERS

HARRISBURG LEAGUE FOR
MUNICIPAL IMPROVEMENTS

JAMES H. FUERTES
CIVIL AND SANITARY ENGINEER
SEPTEMBER 1901

Paxton Creek is now a deadly menace to health and a stench in the nostrils n improved as proposed, it will be as clean and pure as a country brook.

THE PLAIN TRUTH ABOUT THE IMPROVEMENTS

How the City Can Have at a Trifling Cost to Each Taxpayer Pure Water • Protection from Typhoid Fever • Modern Sewerage Parks and Playgrounds

PROPOSED MUNICIPAL IMPROVEMENTS FOR HARRISBURG, PENNSYLVANIA

Condensed Report of the Executive Committee to the Subscribers
to the Fund for Investigating Municipal Improvements,
November 21, 1901, embodying Recommendations of Experts Employed

INCLUDING

JAMES H. FUERTES, of New York
Engineer for Filtration and Sewerage

WARREN H. MANNING, of Boston
Park Improvements

M. R. SHERRERD, of Newark, N. J.
Engineer for Paving

PUBLISHED BY THE
HARRISBURG LEAGUE FOR MUNICIPAL IMPROVEMENTS
OFFICE: 120 MARKET STREET, HARRISBURG, PA.

352.0742
H24

NO GREAT INCREASE IN TAXES

IN considering the probable increased tax rate, an estimate of which is presented on pages 4 and 5, it is well to remember that the present tax rate for the city of Harrisburg is comparatively low. There are only seven cities in the United States having a lower tax rate, for city purposes, than Harrisburg. It is not to be expected that the most important improvements ever undertaken for the benefit of the city can be secured without cost. It is to be hoped that the number will be very limited who are not willing to pay the very reasonable amount necessary to secure results of such great and vital importance to the welfare and safety of the city of Harrisburg, at the same time inaugurating an era of prosperity and growth to the city which will be unprecedented in its history.

ACTUAL COST TO RENT-PAYERS OF ALL PROPOSED IMPROVEMENTS

Pure Water, Paxton Creek Clean-up and Flood-Prevention, Better Sewers, Less Malaria and Mosquitoes, More Parks, Justice in Street Paving

IF YOUR LANDLORD DOES THE SQUARE THING

HE CAN ONLY INCREASE THE RENT ON A PROPERTY TAXED AT $1,000 VALUATION	UNDER MOST UNFAVORABLE CONDITIONS	UNDER PROBABLE CONDITIONS
In 1902—NOT A SINGLE CENT		
" 1903—Increase of	6¼ cents per month	4 cents per month
" 1904— "	12½ " " "	8¼ " " "
" 1905— "	19 " " "	12½ " " "
" 1906— "	25 " " "	17 " " "

This is for valuation of $1,000 only. For higher valuation, increase in proportion.

If the Landlord asks more than this increase, you will know why he wants it—FOR HIMSELF, not for the Improvements!

6 Je/12 m.N.R

PROPOSED CITY IMPROVEMENTS

REALIZING that in many respects Harrisburg, so splendidly situated for both convenience and beauty, is lacking in the requisites of modern city life, and that therefore her prosperity is reduced and the lives of her people endangered, a number of citizens contributed, in the summer of 1901, a fund of $5,000 for the employment of experts of the highest standing upon the various problems involved.

After long and patient investigation, the three engineers whose names appear on the title-page were engaged. Each made a careful and exhaustive study of the problems committed to him, and submitted his findings, together with the necessary maps and plans, to a meeting of the Executive Committee charged with the handling of the work.

These reports were published in October, 1901, and the volume of 128 pages and 14 maps and plans containing them has attracted widespread attention outside of Harrisburg, as a notable contribution to the literature of civic advancement. The Philadelphia *Press*, for instance, has held it up as providing a plan for making Harrisburg a model city, and has urged the adoption by other municipalities, including Philadelphia itself, of "the Harrisburg plan."

The reports are voluminous, suggesting many plans for attaining the objects aimed at. For instance, Mr. Fuertes submits twenty-four distinct plans for the abatement of the Paxton Creek nuisance; Mr. Sherrerd gives elaborate working specifications for all suitable pavements, etc. The present pamphlet presents only the recommended plans, in an abridged but perfectly consistent form, together with careful estimates of the probable increase in taxation required to effect the improvements proposed, as arrived at, after thorough consideration, in consultation with the proper city officials.

A short statement of the improvements proposed may be seen on the fourth or outside cover page.

Every citizen is urged to inspect the detail plans and drawings, in connection with the complete report, which are now accessible at the Headquarters of the League, 120 Market street. The Headquarters are open from 8 a. m. until 9 p. m.

35491

COST OF PROPOSED IMPROVEMENTS

A CAREFUL and conservative estimate of the cost of the proposed municipal improvements, taking into consideration all of the conditions which should enter into an estimate of this kind, has been fixed at

**Two mills on each $1,000 assessed valuation,
or $2 per year, 16⅔ cents per month,
or about ½ cent per day.**

In making the above estimate it is assumed that the present careful and efficient administration of the finances of the city will be continued, irrespective of party.

The improvements proposed are so vitally necessary (**pure water, better health, better sewers, more parks, better streets**), and the cost of securing them so small in proportion to the results to be attained, that, as a business investment, for civic pride or as a sanitary measure, every citizen is justified in voting for the loan.

COST UNDER MOST UNFAVORABLE CONDITIONS

The matter of cost to the taxpayer, however, should be considered under the most extreme and unfavorable conditions possible to occur. Let us assume, therefore :

1. That there will be NO INCREASE WHATEVER in the assessable valuation of the city, during the four years it will require to complete the proposed improvements, the present valuation (May 30, 1901) of $26,631,875, remaining the same for four years. (This is an impossible assumption, the increase averaging $550,000 for the past few years. The amount of increase represented by building permits alone in 1901 exceeded $850,000).

2. That there will be NO ACCUMULATION OF SINKING FUND during the four years, applicable toward the reduction of the proposed debt. (The law requires $\frac{1}{30}$ of the amount expended in any one year to be set aside as a Sinking Fund for the redemption of the principal of the debt. The amount set aside in the four years would be $90,000.)

3. That there will be NO REDUCTION OF THE CITY OR WATER DEBT during the four years. (As a matter of fact, the sum of $40,000 annually for the past few years has been placed in the Sinking Fund for the ultimate extinguishment of the debt.)

4. That the ENTIRE SUM TO BE VOTED FOR WOULD BE EXPENDED—$1,090,000. (The estimate of Mr. Fuertes was a MAXIMUM

amount. To this was added 20 per cent. A saving of $90,000 can therefore reasonably be expected. The paving fund of $100,000 will be authorized but not appropriated.)

Under the above extreme, unfavorable and impossible conditions the **maximum increase** tax rate at the end of four years would be 3 mills on each $1,000 assessed valuation, based on the *present* assessment of $26,631,875, as follows:

For the year 1902, NO INCREASE IN TAX.
" " " 1903, ¾ of 1 mill, ($0.75 per year per $1,000 valuation).
" " " 1904, 1½ mills, 1.50 " " "
" " " 1905, 2¼ " 2.25 " " "
" " " 1906, 3 " 3.00 " " "

This amount or rate of tax would gradually decrease with the extinguishment of the debt through the Sinking Fund.

While the above estimate has been made to give the *maximum* cost of the improvements under any conditions,

THE FOLLOWING FACTS JUSTIFY THE BELIEF THAT THE ACTUAL COST WILL NOT EXCEED 2 MILLS ON EACH $1,000 OF ASSESSED VALUATION

New buildings, as indicated by the building permits issued in 1901, were erected, to the value of $850,000. The natural increase for the next four years is expected to be at least $1,000,000 per annum, or $31,000,000 as a basis of valuation for the proposed improvements. With the stimulus given by these improvements, through increased population and new enterprises, the increase will no doubt be very much in excess of this estimate.

The amount of loan to be voted is	**$1,090,000**
The estimate of Mr. Fuertes was for a maximum amount, to which was added 20 per cent. The amount to be expended will possibly be reduced by	**90,000**
Making a conservative estimate of	**$1,000,000**
The paving fund authorized but not appropriated amounts to .	**100,000**
	$900,000

Or, $900,000 on which the increase of taxation, at the end of four years, should be based. The paving fund will only be available in the future when petitions are presented and legislation enacted for the paving of streets, when such portion as may be necessary to pay for intersections or other portion of said paving may be appropriated. The reduction of mill-rate by the liquidation of the debt through the sinking fund will no doubt have been started by the time the paving fund will be required. This fund is, therefore, eliminated from the amount on which the increase of tax will be based.

COST UNDER PROBABLE CONDITIONS

THE surveys, legislation and construction of the proposed improvements will require about four years to complete, and will make an annual average expenditure of $225,000.

For the first year — (1902)	**No bonds can be issued and consequently there can be NO INCREASE OF TAX**	
For the second year — (1903)	Interest on $225,000 at 3½ %	$7,875.00
	Sinking fund $\frac{1}{30}$	7,500.00
	State tax, 4 mills	900.00
	About ½ mill increase.	$16,275.00
For the third year — (1904)	Interest, sinking fund and state tax	32,550.00
	About 1 mill increase.	
For the fourth year — (1905)	Interest, sinking fund and state tax	48,825.00
	About 1½ mills increase.	
For the fifth year — (1906)	Interest, sinking fund and state tax	65,100.00
	About two mills increase.	

The city and water debt is being rapidly liquidated at the present time. Over $40,000 annually is placed in the Sinking Fund for the payment of the debt. In five years, when the improvements are fully completed, and all of the bonds issued, this reduction or application to the Sinking Fund will amount to $200,000.00

The amount placed in Sinking Fund on account of proposed improvements the second year	$ 9,000.00	
The third year	18,000.00	
The fourth year	27,000.00	
The fifth year	36,000.00	
Or added to Sinking Fund in the five years		$90,000.00
		$290,000.00

While the improvements may cost $900,000 by the time they are completed, at the end of five years there will be accumulated in the Sinking Fund of the city, applicable to the extinguishment of the city's debt, the sum of $290,000. The new bonds should be made 5–30's, so that after five years they can be called and paid as the Sinking Fund may warrant. The financing of the city loan for improvements so long needed will be a simple matter, at a small cost to taxpayers. After five years the amount applied to the Sinking Fund *annually* would be:

On account of city and water debt	$40,000.00
On account of proposed improvements	36,000.00
Total annual accumulation	$76,000.00

REPORT OF EXECUTIVE COMMITTEE

HARRISBURG, PA., *Oct. 20, 1901.*

To the Subscribers to the Fund for Investigating the Subject of Municipal Improvement.

GENTLEMEN:—At a meeting of the subscribers to the fund in question, held May 17, 1901, the following resolution was unanimously adopted:

"*Resolved,* That an executive committee of seven be appointed by the chair to act upon the subjects, for which the fund has been subscribed, and that this Committee have the authority to employ and pay experts and other necessary expenses, reporting to this body its conclusions, and that this Committee invite the Mayor and City Engineer and one Councilman from each body to act with it."

Your committee appointed at a meeting held May 17, 1901, after careful inquiry and investigation, selected James H. Fuertes, of New York City, to take up the subject of Water and Sewerage; Warren H. Manning, of Boston, the subject of Parks, and M. R. Sherrerd, of Newark, N. J., the subject of Streets.

All of these gentlemen came to your Committee most highly recommended as competent experts in the several departments of work assigned them.

I.—WATER WORKS AND DRAINAGE.

The report of Mr. Fuertes is not only a very complete, but a very elaborate one. It treats, *First,* of the improvement of the sanitary condition of and the prevention of floods in Paxton creek; *Second,* the improvement of the water supply of the city; *Third,* the improvement of the sanitary condition of the Susquehanna river front, and *Fourth,* the improvement of the sewerage system with recommendations as to the proper policy to be followed in future extensions.

As covering his entire subject, he recommends:

1. That Paxton Creek "be retained in its present channel, as an open stream, that its section be enlarged, its bed deepened, its slope steepened, and that the dry weather flow or sewage now going into the Creek be diverted into an intercepting sewer five feet

in diameter, reaching from Schuylkill street to the Susquehanna River at Tuscarora street," at an estimated cost of $249,700.

2. The construction of "a rapid filter plant of a daily capacity of ten million gallons, using the present reservoir for sedimentation purposes, and building a new seven and one half million gallon reservoir for filtered water, near the site of filters," at an estimated cost of $279,000.

3. The improvement of the sewer system by establishing "the combined system for the territory draining toward the Susquehanna River, and the separate system for all future extensions in the territory draining to Paxton Creek from the hills on the east side of the valley. For the part of the side west of, but draining into, Paxton Creek, he recommends the combination system, the sewers to be arranged so that the dry weather flow will go into an intercepting sewer, and storm water overflow to Paxton Creek."

In connection with this branch of the general subject, he recommends that the general sewerage system now installed be improved by re-constructing all sewers which are *First*, of insufficient capacity; *Second*, too near the surface, and *Third*, in generally poor condition. He notices in detail the particular sewers requiring reconstruction, the defects which are incident to the present system, and the scope of the work necessary to place it in the best possible condition in accord with the most improved theories of construction. The estimated cost is $77,256.40.

4. The improvement of the sanitary condition of the river front by erecting a low dam, four and one-half feet in height, at Conoy street, so constructed as not, in any way, to impede the flow of water or the sewage at present carried by the river. By the construction of this dam, he shows that slack water will be created at low stages of the river as far up as Maclay street; that by thus deepening the water on the river front all the sewers emptying into the river will be well covered at the lowest stages of water, that all disagreeable odors and unsightly conditions will be removed, and that the construction of such dam will not in any way impede navigation or obstruct the natural flow of the water. The estimated cost of this improvement is $55,000.

The entire cost of these improvements, as recommended by Mr. Fuertes, is $660,956.40, which in view of the importance as well as the completeness of the work, and the results to be accomplished, your Committee are gratified to be able to say, is much below what they had anticipated.

It is obvious that the present bad conditions, particularly with respect to sewerage, will be dangerously increased by the abandonment of the Pennsylvania canal and the discharge into Paxton Creek of the sewage which has heretofore gone into the canal, so that prompt and radical action upon the lines suggested is not only necessary, but of vital concern to every man, woman and child in the city.

II.—PARKS AND OPEN SPACES

The report of Mr. Manning, whilst dealing with a subject which appeals to an entirely different sentiment from that suggested by the report of Mr. Fuertes, is well worth careful attention.

The phenomenal increase of population in the United States is almost entirely urban, so that, it is apparent, in the future the great mass of population will live in cities. The average citizen who has made his home in a city has the right to expect, and is entitled to enjoy, the best conditions with respect to health and general welfare that the environment in which he lives will permit. He is not satisfied, and indeed ought not to be satisfied, with anything less, and no city of the present day can answer the reasonable demands of the citizen in that regard unless it has established and maintains, so far as existing conditions will permit, a system of public parks and play-grounds, in which the entire community will have an interest.

A study of Mr. Manning's report will show that it is made substantially upon these lines. His recommendations embrace a comprehensive system of parks, play-grounds, walks and drives.

In the southern section of the city, he recommends the acquisition of what is known as the George F. Mish property, between Paxton and Cameron streets, and the wooded creek valley below it, which in his opinion, with "its splendid view, the fine trees surrounding it and the rich soil, would form an ideal site for a small park."

He also recommends the extension of Reservoir Park, so as to include "the whole summit of the ridge and about one-half of the northerly slope, down to a point where a plantation would shut out the immediate foreground of houses in the valley," connecting it with the proposed filtration farm, which would then become a part of the Park System.

In the development of the general system, he suggests the control by the city of "the wooded bluffs of Paxton Creek valley, and enough of the banks of the Creek to preserve the trees," utilizing these for the construction of walks and drive-ways where possible, so as to connect the various parts of the general system, as shown upon the plans submitted.

For the northern part of the city, he says, "The opportunity for a great country park at Harrisburg lies to the north of the city in the tract known as Wetzel's swamp, which includes about five hundred acres of swampy and dry land, framed in with wooded bluffs on the one side, and a line of fine old willows along the canal on the other. As it stands today it is a natural park with beautiful passages of landscape, and fine vistas, over great stretches of meadow land to distant hills beyond. It is rare, indeed, that a city can secure a property having all the elements of a park landscape, its border-planting of fine trees, splendid individual specimens, and woodlands carpeted in spring with numerous wild flowers."

"Here, also, there is a comparatively level and perfectly dry upland, that, with but little clearing and the removal of pens and sheds, can be made available for picnics and games. In the meadows, masses of brilliantly colored flowering plants, which the upland cannot produce, are found, giving color effects, at different seasons of the year. This region is quite accessible by steam and electric cars, and there are roads, at several points, across the meadow and for a long distance along the boundaries. The swampy condition which prevails upon much of this land can be remedied, for there is abundant fall for all drainage through Fox's run and Paxton Creek."

Your Committee has gone over most of the ground which is intended to be included in the proposed Park System, and have been much impressed with its comprehensive character, as well as with its natural beauty, and with the comparatively small expense for which it can be carried out.

Manifestly the financial condition of the city will not at present permit the carrying out of Mr. Manning's system in all its details. A substantial beginning, however, can be made, and your Committee recommend that proper steps should be immediately taken to at least acquire some of the locations which are essential to the carrying out of the system.

Assuming that the improvements in respect of the Water and Sewerage System can be effected at a cost not exceeding the amount estimated, there will still be an available margin within the constitutional limitation of debt, which could be applied to the beginning, at least, of a comprehensive Park System. This might properly involve the acquisition of the Mish property, and a portion of Wetzel's Swamp, the proposed extension of Reservoir Park, and the control of the banks, as far as possible, of Paxton creek, and the adjacent wooded bluffs.

Under an Act of Assembly, approved May 11th, 1901, the cities of the Commonwealth are authorized "to purchase, acquire, enter upon, take, use and appropriate private property for the purpose of making, enlarging, extending and maintaining public parks, within or without the corporate limits of such cities, whenever the councils thereof shall, by ordinance or general resolution, determine thereon: Provided that where said property is outside of the city, it may be annexed thereto by ordinance of such city."

Under this Act, the City Councils could at once take such action as would at least inaugurate a beginning of the Park System recommended, so far as the financial conditions of the city will permit. If this were done, a natural development would necessarily follow, and in a few years the city of Harrisburg would be possessed of a Park System which would rival that of any other city of its size in the country.

By another Act of the Legislature, passed May 17th, 1901, the charter of cities of the third class was so amended, as to authorize the creation of "Any office, public board or department," which councils "may deem necessary for the good government and interest of the city, and to prescribe the powers thereof." Under this Act, a Park Commission could be created, which could take title to and control all the property which it might be found necessary or feasible to acquire for park purposes, and this of itself would be a substantial commencement of the work.

Your Committee, therefore, recommend that Mr. Manning's report as a whole be adopted, and that such action be taken by the proper authorities as will inaugurate the proposed Park System and enable the city to acquire control of the necessary property, and at the same time, to create a Board of Public Parks, with such powers as may be necessary, to develop the system, with a view to eventually carry out Mr. Manning's plan.

III.—STREETS AND PAVING.

The report of Mr. Sherrerd treats of Pavements and the proper methods for their construction and repair. It is accompanied by plans and elaborate specifications, from which any citizen can see for himself what kind of pavement may be proper for any given locality, how it ought to be constructed, and the relative cost of each kind.

For purely residential streets he recommends macadam pavement, varying in depth, according to the traffic to which it may be subject; for streets where the traffic is heavy and very much congested, he recommends granite block pavement, as the most "durable and at the same time most serviceable in all kinds of weather;" for some of the business and residential streets he recommends asphalt pavement on a concrete base, and a brick pavement on a concrete foundation for such streets as Mulberry and East State streets.

In discussing the general subject, he says, "It is not well to lay asphalt on streets that have an exceptionally light traffic, as this pavement needs a moderate amount of traffic to insure its life." He suggests that brick pavements are more suitable than asphalt for streets having a heavy grade; that in cases where streets have been more or less macadamized, the macadam now existing may be used to advantage on the street, in the preparation of the foundation for a more improved pavement, and that in some cases a combination of brick and asphalt pavements may be used to advantage, as for example on Thirteenth and Derry streets.

Speaking of asphalt block, he says, "When well laid it has given satisfactory results. I believe, however, that it should only be laid on such grades as will entirely prevent water from standing on the pavement at any point. You have some fairly good examples of this class of pavement, but my experience has shown that whenever a slight depression exists to hold water for any length of time the blocks at this point begin to disintegrate."

Mr. Sherrerd's report gives special attention to methods of construction, including street car track construction, catch basins and such details as are necessary to secure the best results. He also discusses the several kinds of pavement, not only those recommended, but others which are in use showing the advantages and disadvantages of each, so that, by a careful study of the report, an intelligent conclusion can be reached by any one, with respect to the desirability of any kind of pavement.

Your Committee does not deem it necessary to do more than suggest an outline of Mr. Sherrerd's work. The specifications which he has submitted cover, in a most thorough manner, every possible detail, and if they should be adopted as standard specifications for the several kinds of pavements suggested, it is sufficient to say that the city would secure the advantage, not only of the best kinds of pavement adapted to existing conditions, but the best possible construction in all its details.

Your Committee, therefore, suggest that it be recommended to city councils, to adopt these specifications as a standard, in the construction of all future pavements, and that they be given such publicity that every citizen may know for himself, not only what pavement is best adapted for a given street, but may be sure that when laid, it will be constructed in the best possible manner.

Your Committee believes that it will be generally conceded, that the city of Harrisburg is not up to date in the matter of improved pavements. Its progress on that line has been slow, and in some respects unsatisfactory. As a result of the policy of imposing the entire cost of construction upon the abutting property owners, much dissatisfaction has been engendered, and litigation incurred.

After a full and careful consideration of the entire subject, as an incentive to the construction of more and better paved streets, your Committee recommend that at least a portion—one-third, or perhaps one-half—of the expense of putting down a pavement for general traffic should be borne by the city. If this policy were adopted by councils, it is reasonable to believe that a general movement, in the line of better paved streets, would be inaugurated, and in a very short time, the city of Harrisburg would have reason to be proud of the condition of her streets, in respect of pavements at least.

IV.—SUMMARY.

In discharging the duty devolving upon it, your Committee has sought to obtain, on each branch of the subject committed to it, the best possible engineering talent. How thoroughly the work has been done, will appear from the several reports, which with the accompanying plans, drawings, etc., are submitted as a part of the General Reports, now on file, with full details of construction. Without discriminating it may be properly said that they will each merit the most careful study by every citizen who is interested in the welfare and improvement of his city.

With a view to inaugurate the proper movement on the part of city government, and to carry out the several recommendations of the engineers, as far as possible, your Committee suggests that councils should be requested, as soon as practicable, to pass a proper ordinance, looking to the submission to the voters at the spring election of the question of incurring the debt necessary in making the improvements contemplated.

Your Committee has been informed that upon the present assessment, an additional indebtedness of $1,091,476.35 may be created within the constitutional limitation. In estimating the present indebtedness of the city, it has been suggested that the water debt, which represents an investment rather than a debt, should be eliminated. If this could be done, a much larger indebtedness for general city improvement could be incurred, and it is, therefore, a subject entitled to consideration by councils.

It may further be properly suggested that it might be well, in order to secure the best results, that a Board of Public Works should be created under the Act of 1901, to have charge of the expenditure of all moneys devoted to public improvement, outside of public parks. Respectfully submitted,

Vance C. McCormick
Robt Snodgrass
Thos T. Wierman.
J. Horace McFarland.
D. L. Jauss
John A Affleck
Edw Bailey.
H. M. Holstein councilman
M. B. Cowden City Engr.
Jno A Fritchey Mayor
H. B. Walter Solct-Councils

NOTE.—Since the above report was submitted to and approved by the contributors to the original fund of $5,000, on October 25, 1901, an ordinance has been prepared, passed by the Councils, and approved by the Mayor, submitting the question of increasing the debt of the city for the purposes named at the ensuing election, February 18, 1902. An ordinance creating a Board of Public Works is now on passage. All these steps have been taken with the utmost care, and upon competent legal advice.

REPORT ON PAXTON CREEK, WATER SUPPLY, RIVER FRONT AND SEWERAGE*

HARRISBURG, PENNSYLVANIA,
September 2, 1901.

It gives me much pleasure to submit herewith, in response to your instructions, a report covering the following subjects:

1. The improvement of the sanitary condition of and the prevention of floods in Paxton Creek.
2. The improvement of the water supply of the city.
3. The improvement of the sanitary condition of the Susquehanna River front.
4. The improvement of the sewerage system, with recommendations as to the proper policy to be followed in future extensions.

PLANS AND COSTS.

1st. For the treatment of Paxton Creek, I find that in order to prevent the fouling of the creek it will be necessary to divert all the dry-weather flow of sewage now finding its way to the stream into an intercepting sewer to discharge into the Susquehanna River at the foot of Tuscarora street; that to prevent floods occasioned by high water in the Susquehanna River is impracticable, but that floods from Paxton Creek may be prevented most cheaply by enlarging the present channel of the creek, and maintaining it as an open channel in its natural course.

2d. For the improvement of the water supply, I find that to secure clear pure water at all times it will be most satisfactory to instal a rapid filter plant, to be operated with alum as a coagulant, and maintain the pumping station and the intakes in their present positions. Before filtration it will be most economical to provide for about twenty-four hours simple subsidence.

3d. For the improvement of the sanitary condition of the Susquehanna River front, I find that the most satisfactory method,

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* NOTE.—This report is very much abridged in this pamphlet. Copies of the complete report may be seen at 120 Market street, the headquarters of the League.

from all points of view, will be to construct a dam across the river, below Conoy street, the dam to be high enough to create slack water in times of low summer flow as high up the stream as Maclay street.

4th. For the improvement of the sewerage I find that the combined system should be employed for all sewers emptying into the Susquehanna River and into Paxton Creek from the west side of the same, while the separate system would be the best and most economical for the portion of the city lying east of the creek. I further find that certain portions of the city are inadequately sewered, either by reason of the sewers being too near the surface, too small, or in too poor a condition to make repairs justifiable. The details of the necessary corrective works are described in full in the following pages.

The respective costs of these improvements are as follows:

For the prevention of floods and the improvement of the sanitary condition of Paxton Creek	$249,700
For the improvement of the water supply	279,000
For the improvement of the sanitary condition of the Susquehanna River front	55,000
For the improvement of the sewerage system	77,256
Total	$660,956

The reasons upon which the foregoing conclusions are based are given in full under the discussions of the different subjects, in the following report. Respectfully submitted,

JAMES H. FUERTES.

INTRODUCTORY.

In undertaking the investigations of the subjects mentioned in your letter of instructions, it was necessary to decide at the outset the limits to which the studies should extend. Manifestly, it would be impossible in ten weeks to prepare working drawings for so many and such important works. It seemed, therefore, that the principal object of this report should be to determine the proper policy to adopt in the general treatment of the different problems, leaving the working out of the details for a later time. It may be, therefore, that some of the designs upon which the estimates of cost have been based, may advantageously be changed somewhat upon a more intimate acquaintance with local circumstances and requirements. Such changes, however, would not alter the general conclusions nor greatly affect the estimates of cost.

Quite a large amount of field work has been done to obtain the necessary information, and the estimates are given with the assurance that they will prove ample to cover not only the cost of construction, but the cost of land, as well as incidental, legal and engineering expenses. They are all strictly comparable, and their totals will enable you to judge of how the different plans compare both as to cost of construction and annual cost of maintenance.

The items given, include, in all cases, interest at the rate of 3½% per annum, the cost of repairs, an allowance for depreciation to cover the cost of renewals, and the superintendence and labor necessary for operation.

THE IMPROVEMENT OF PAXTON CREEK.

Paxton Creek drains quite a large area lying to the north and east of Harrisburg. Above the south line of the city its drainage area is 23.9 square miles, while about 3 miles north of State street, where the channel makes a semi-circular bend in entering the flat portion of the valley, its watershed is 16.4 square miles. The headwaters of the creek are in the foot hills of the Blue Mountains and in the rolling country near Linglestown. As the principal tributaries join the main stream within a distance of 2-1/2 miles of each other, all these branches, during heavy rains, discharge into the main channel at about the same time. On account of the small water way and the flat slope in the lower course of the stream the water cannot flow off as quickly as it comes down from the hills, and the flooding of the valley results. Sometimes a portion of the flood water finds its outlet through Fox's Run, but the greater part flows down through Harrisburg to the Susquehanna, doing more or less damage on the way.

Where the stream passes through the city it receives the discharges from several large sewers, which, during dry weather, pollute the water and foul the shores and bottom of the creek to a very objectionable extent.

In studying methods for the proper treatment of the creek, therefore, two points must be considered: The prevention of destructive floods, and the maintenance of the channel in proper sanitary condition. These considerations require a knowledge of the quantity of water flowing in the stream during the floods as well as during periods of small or minimum flows; the former in order to determine how large a channel should be provided for removing the floods, and the latter in order to ascertain how much sewage may be discharged into the creek without fouling it to the point where it will become offensive and dangerous to health.

In its present condition the channel is too small to remove the floods, while during dry weather the pollution of the water is so great as to make it a nuisance and a positive menace to the health of the residents of the city.

After a personal reconnaissance of the watershed of the creek, I have, with the aid of the best data available, estimated the stream flow under different conditions to be as follows:

At the south line of the city: area of water shed, 23.9 square miles; flood flow, 1,073 cubic feet per second; minimum flow, 2.8 cubic feet per second; ordinary low water flow, 11 cubic feet per second.

At the bend 3 miles north of State street: area of water shed, 16.4 square miles; flood flow, 862 cubic feet per second; minimum flow, 1.7 cubic feet per second; ordinary low water flow, 7 cubic feet per second.

HOW MUCH POLLUTION?

A flowing stream whose waters are not used for domestic purposes may stand a certain amount of pollution without becoming offensive. The permissible amount of pollution will depend upon the quantity of water flowing in the stream, and the character of its channel, as well as upon the amount and kind of polluting matter already in the water. When caused by sewage it is more convenient and rational to express the amount of pollution in units of population rather than in actual quantities of polluting matter. The average amount of solid matter contributed per person per day is quite constant, while the quantity of water forming the liquid part of sewage varies greatly in different cities, ranging from about 30 to over 200 gallons per capita per diem.

In general terms it may be stated that a flowing stream free from pools, with its bed covered with water and its banks smooth enough not to catch floating matters, may receive for each cubic foot of water flowing through it per second the sewage of from 200 to 330 people without creating a nuisance. When it receives the sewage of only about 150 people to each cubic foot of flow per second it is certain that no nuisance will result; when it receives the sewage of 500 or more people, for each cubic foot of flow per second, a nuisance will surely follow. This gives us a measure of the extent to which Paxton Creek may safely serve as an open sewer. By reference to the following table it will be found that the minimum flow of the stream at the south line of the city is about 2.8 cubic feet per second. At such times it could receive properly the sewage of about 1,000 people, but would be polluted to offensiveness by the sewage of about 1,500 people.

At the time of ordinary low-water flow we find that the stream might, under proper conditions, receive the sewage of about 3,500 persons, but that it would certainly become offensive when receiving the sewage of 4,500 people. The following table shows that at the present time the sewage of about one-third of the population of the city finds its way into the creek, as follows:

Ward	Population, 1900 Census	Estimated Population Using Sewers
1st	3909	1800
2nd	4269	3000
7th	7200	6000
8th	4400	3500
9th	6455	5100
10th	1906	600
		20000

From the foregoing it is seen that the stream now carries over five times as much sewage as could be safely discharged into it at ordinary summer stages, and twenty times as much as would make it offensive during a very dry season.

The correctness of these data is attested by the fact that at State street, on August 1st, 1901, with a flow of about 15 cubic feet per second, the creek was decidedly offensive with the sewage of 6,600 people, or a little over 400 people per cubic foot of stream flow per second. It is evident, therefore, that it would be improper to permanently continue to use the creek for the reception of the sewage of more than from 2,000 to 3,000 people, were it to be maintained as an open channel. Further, as the population residing in the districts draining into the creek is now nearly 24,000, and will in the future probably reach 50,000, it is clearly evident that its use as an open sewer must be prohibited. To flush it out with water from the city mains would be impracticable by reason of the great distance such flushing would have to extend, and the great quantity of water which would be necessary to create sufficient velocity of flow in the channel to carry along the suspended matter. Hose streams applied at points where decomposing matters had accumulated would undoubtedly disperse them, but unless the flow in the channel were sufficiently rapid and deep to carry the loosened matters along the mouth of the creek, deposits would form again a short distance below. To supply a sufficient quantity of water to carry out the deposits at the ordinary summer stage of the stream would require a pumping plant capable of supplying six times the amount of water now consumed by the city for all purposes.

FLOODS IN PAXTON CREEK.

The floods in the creek must be studied in connection with the fluctuation of the level of the water surface of the Susquehanna River, as high water in the river affects the water surface in the creek, and thus the carrying capacity of the stream.

Occasionally high floods come down the river, caused by excessive rains in the upper valley, and these rise to much greater heights than the average or usual winter or spring floods.

Placed in the order of their occurrence the recorded heights of the river at the pumping station during the great floods were as follows:

1846	311.55	feet above sea level.
1865	314.30	“ “ “ “
1886	310.64	“ “ “ “
1889	316.47	“ “ “ “
1894	314.97	“ “ “ “

The frequency of these floods follows no general law.

The average slope of the water surface of the Susquehanna at Harrisburg, at moderate flow, is about 2 feet per mile, and during the floods probably about the same when the flood is at its greatest height, while it is greater when the river is rising. At the mouth of Paxton Creek, therefore, the flood heights might be expected to be two feet lower than at the water house. Floods reaching a height of 312 feet above sea level at the water house would, therefore, flood back through Paxton Creek, and submerge perhaps the greater part of the flat land up to the north line of the city.

Since the beginning of 1895, the river level has not been high enough to overflow the banks of Paxton Creek and flood the flat lands. Evidently, therefore, the floods of the valley are of two kinds, those caused by the Susquehanna River and those caused by Paxton Creek.

"AN OUNCE OF PREVENTION."

There are two methods of preventing the flooding of the lower Paxton Creek Valley by backwater from the Susquehanna. The first would be to build dykes along the banks of Paxton Creek from the bend three miles north of State street to the mouth of the creek, carrying one dyke north along the bank of the river as far as Washington street, and the other south along the river to the line of Cedar street, and thence east to Cameron street, thus closing out the river water but permitting Paxton Creek to discharge through its natural channel. For this method to be effective the dyke would have to be carried across the Pennsylvania Canal, closing the canal channel. At the same time it would be necessary to divert the surface waters from the hills into channels cut along the foot of the bluff. These channels should be high enough to be above the greatest flood level in the valley, and should discharge part of the surface water into Paxton Creek, at the bend, and part into Spring Creek at the south line of the city. A sewer would also have to be provided along the creek for the purpose of intercepting all the house sewage and storm water from the streets in the area draining to the creek, and a pumping plant would have to be provided so that the sewage could be pumped away when the river was too high to permit a gravity discharge. This would occur on the average probably only once in ten years, and the pumps would have to run them only about two days.

Another way to prevent back-flooding would be to cut a new channel for Paxton Creek, leading it into the Susquehanna through Fox Run, about 4 miles north of the city, throw a dyke along the river bank from Washington street to the line of Cedar street, and thence to South Cameron street, diverting the water from the hills on the east side of the valley into Paxton Creek at the bend and into Spring Creek at the south line of the city, and intercepting the sewage as in the previous method.

This would cost about $540,000 and the annual expense would be about $21,000.

In the following discussion it must be borne in mind that the works described are not designed to prevent the flooding of the valley if the surface of the Susquehanna River should be up to 305 at the mouth of Paxton Creek at the time the Creek was in its maximum flood—such a coincidence of floods would throw the creek out of its banks and flood the valley. The probability of such an occurrence, however, is very remote, because the floods from Paxton Creek rise very rapidly after a heavy rain, while floods in the Susquehanna are caused by storms of smaller intensity of rate but covering a greater extent of country. Storms and conditions that cause great floods in the river do not cause heavy floods in Paxton Creek, while storms causing the great floods in Paxton Creek would not appreciably affect the flow in the Susquehanna River.

There are four general plans on which the works for the protection against floods from Paxton Creek may be designed. These are, (1) the provision of a channel of suitable cross-section and slope; (2) the diversion of the floods into Fox Run; a suitable channel and accessory works being provided therefor; (3) the retention of the floods in the upper valley of the creek by means of dams proportioned so as to catch the flood waters; and (4) combinations of the above methods.

Before discussing the various means of preventing the floods in Paxton Creek valley, it would be well to determine approximately what expenditures are warranted for accomplishing this purpose. The great river floods occur at infrequent intervals, averaging perhaps ten years apart. It is very difficult to estimate the damage done by these floods in money values, but if we assume provisionally that the damage done by a single flood might reach $100,000, including the damage to private property, the cost of cleaning up after the flood, and the repairing of streets, bridges, houses, etc., an expenditure of about $10,000 per year on the part of the city to secure protection would be warrantable.

KEEP THE FILTH OUT!

One feature which must be a part of any scheme for protection is to provide for keeping the city sewage out of the creek, in order to protect the general health of the community; therefore, the cost of this part of the work should not be a charge against protection from floods. As however, the work for protecting the valley from floods must be done at the same time as the work for preventing the fouling of the creek, the costs of the two works are given together in the estimates which follow, and, therefore, in order to make comparisons between the estimates and the allowable yearly expenditure for protection works, the annual cost of the nuisance-prevention works should be added to the sum above mentioned. This cost, including interest, depreciation, and operation and maintenance would average about $5,000 per year, and, therefore, if we add $5,000 to the $10,000 above mentioned for guarding against floods, we arrive, provisionally, at the sum of $15,000 as the allowable yearly expenditure for protective works.

In deciding what cross section and slope to give the stream it is necessary to consider both concrete lined channels and channels excavated in the natural soil, because the rapidity of flow of the water in the channel depends, other things being equal, upon the nature of the surfaces along which the water glides. If the channel is smooth the stream may have a smaller cross-section and a flatter slope than if it were rough. This fact influences cost, and in order to determine the relative advantages of the various combinations possible, I have worked out in detail twenty-four plans for treating the creek.

These may be grouped into four general classes, as follows:

1. The treatment of the present creek channel after taking out the city sewage.

2. The treatment of the present creek channel in connection with a dam on Paxton Creek to hold back some of the flood water, and the interception of the city sewage.

3. The diversion of the floods into Fox Run, with the interception of the city sewage.

4. The holding back of part of the floods by a dam on Paxton Creek, and the diversion of the rest of the flood water through Fox Run into the river.

Under each of the above heads there are three methods of taking care of the sewage and storm water of the city. These are as follows:

1st. A small intercepting sewer, along the creek valley, would be provided for receiving only the house sewage, or dry-weather flow of the sewers. This sewer would be small in diameter and the slope necessary to give sufficient velocity of flow to the sewage would bring the sewer out, at the point where it would reach the river, at an elevation too low to enable it to discharge by gravity.

It would be necessary, therefore, to build a pumping station a little below Mulberry street, and raise the sewage to a sewer at higher level. During rains, this sewer would be too small to take the flow of the joining sewers, so that overflows would have to be provided to take the surplus to Paxton Creek. This would be perfectly proper, because at times of such overflows the discharge of the creek would be sufficient to dilute and carry away the sewage.

2d. An intercepting sewer would be built of large enough diameter to discharge the sewage and a little storm water into the river without pumping, and provision would be made for overflows to the creek to act in time of heavy rains, as before. The sewer would be as small as the grade available would permit, yet in order to prevent deposits it would have to be large enough to discharge about 22 cubic feet of creek water per second when the flow of the stream would furnish this amount. This would require a sewer five feet in diameter, with overflows to the creek as above mentioned.

3d. A sewer of large enough diameter to take all the sewage and storm water from the flat part of the valley would be constructed.

ESTIMATES.

All the estimates have been based on running the sewer from the line of Schuylkill street to the river, following the west bank of the creek to State street, then running down Tenth street to the P. & R. railroad. Crossing under the latter it would follow the stream to Paxton street, just beyond which it would pass under the Pennsylvania canal and Pennsylvania R. R. tracks, to Tuscarora street, and thence to the Susquehanna River.

At the mouth of the sewer, a line of cast-iron pipe would lead out into deep water in the river 150 feet beyond the low-water line, in order to prevent the sewage from stranding on the shores. The open end of the sewer would terminate in a masonry wall at the river bank, with wing walls on each side.

Flap gates would be placed over the end of the sewer to prevent the escape of the sewer air at that point, but yet permit the flood waters to pass out. On the upper end of the sewer a catch basin would be provided for the purpose of catching the silt and the stones. Inclined screens of ample size would be placed in the basins to prevent the entrance of floating matter.

The cost of connecting the present and proposed new sewers with these intercepting sewers has been added in all cases, and the estimates represent the total cost of the various projects completed with all the necessary accessory works. In the estimates of cost of the improvement of the stream ample allowances have been made for the cost of all the accessory works, including the underpinning of the bridges, the walling up of the portion flowing through the built up section of the city, the replacing of the Hemlock street bridge with one of longer span, the removal of the pier under the Market street bridge, and all other necessary work. The estimates cover the cost of the intercepting sewer and the improvement of the stream channel from its mouth to the north line of the city. At that point the new channel would be low enough to drain the marshes lying beyond.*

The plan I recommend as presenting the most practicable features for the least expense is known, as "Plan C," as follows (see also Plate, showing details):

PLAN C.

Improvement of present channel of stream by enlarging its section and improving its slope; construction of 5-foot intercepting sewer for house sewage, sewer to discharge by gravity into the Susquehanna at Tuscarora street.

Cost of construction	**$249,700.00**
Annual cost of maintenance, including interest, depreciation, operation and repairs	**10,450.00**

This plan at a cost of $249,700, offers protection against all floods except those from the Susquehanna River, which occur, perhaps, every ten years, on the average.

I feel that were I a property holder in the valley I would rather take the chances offered by the uncertainty in the frequency of the floods from the Susquehanna than the certainty of being taxed every year for protection which might not be needed oftener than once in twenty years.

In consideration of all the foregoing data, therefore, I recommend that Paxton Creek be retained in its present channel, as an open stream, that its section be enlarged, its bed deepened, its slope steepened, and that the dry-weather flow of sewage now going into the creek be diverted into an intercepting sewer, 5 feet in diameter, reaching from Schuylkill street to the Susquehanna River at Tuscarora street.

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*NOTE.—Mr. Fuertes proposes and discusses twenty-four feasible plans, all of which are fully projected in the complete report. Only the recommended plan is given in this pamphlet.

The estimated cost of the work for improving the sanitary condition of and the prevention of floods in Paxton Creek is given more in detail for Plan C, recommended, as follows:

IMPROVEMENT OF CHANNEL FROM SCHUYLKILL STREET TO THE MOUTH OF THE CREEK.

Excavation	$57,000.00	
Walling sides and paving bottom, where necessary, from State street to Market street	15,500.00	
Protecting bottom of creek and abutments of R. R. bridges, crossings, etc	3,700.00	
New bridges at Hemlock and Mulberry streets and changes at Paxton street	12,000.00	
Improvements at Market street crossing	6,000.00	
Lowering State street water mains and incidentals	2,000.00	$96,200.00

INTERCEPTING SEWER.

Excavation and refilling	$28,000.00	
Concrete and expanded metal work	49,000.00	
Manholes,	800.00	
Outfall works	2,000.00	
Settling basins at Schuylkill street	1,000.00	
Connecting existing and proposed sewers, including overflows,	40,000.00	
Extra work crossing under R. R. track and incidentals,	10,000.00	130,800.00
		$227,000.00
Ten per cent.,		22,700.00
Total		$249,700.00

ANNUAL COST OF OPERATION AND MAINTENANCE.

*Interest on $249,700 at 3½ per cent	$8,739.50
Depreciation of perishable parts of works,	60.50
Ordinary repairs and supplies,	600.00
Labor for superintendence and cleaning	1,050.00
	$10,450.00

THE IMPROVEMENT OF THE WATER SUPPLY OF HARRISBURG, PENNA.

The water supply of Harrisburg is derived from the Susquehanna River. The pumping station is located on the bank of the

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*This interest charge is included in the calculation on page 3.—COMMITTEE.

river at the foot of North street, and the water is brought to the pump well through two lines of 30-inch cast-iron pipe, extending out into the river 610 and 704 feet, respectively, and terminating in cages or screening boxes. The pumps force the water through a line of 30-inch pipe to the distribution reservoir at Reservoir Park. The reservoir is 270 ft. wide, 520 ft. long and holds, when the water is 25 ft. deep, 20 million gallons. The elevation of the water surface when standing 26 ft. deep in the reservoir is 500.2 ft. above sea level. The elevation of the floor of the pump room is 305.06 ft., of the cylinders of the pumps about 308 and of the bottom of the suction well 280.7 feet, above sea level. At the pumping station, and connected with the force main, is a stand pipe the top of which is 220.5 feet above the centre of the pump cylinders.

The pumps together have a daily rated capacity of 10,205,000 gallons per twenty-four hours. As the water consumption averages now nearly 8,000,000 gallons per day, it is readily seen that there is no reserve capacity in case of an accident to either pump. To remedy this, a new high-duty pump has been purchased, and preparations are now being made for its installation.

The intake pipes terminate in a deep part of the river, well chosen to secure good water.

FUTURE NEEDS.

In designing works for water filtration it is not necessary to look very far into the future, except to be sure that a sufficiently large tract of land may be secured for future extensions of the works. On the account of the possibility of building additional filters when required it is sufficient to provide filtering capacity for the needs of the city for a few years following the time of the completion of the works. I have assumed that the provision of 10 million gallons daily would be a sufficient quantity to allow for in making the designs on which the estimates of cost are based. At the present rate of increase of population, and with a daily per capita supply of 135 gallons, this would be sufficient for a population of 75,000 people. It is probable, however, that the rate of consumption will increase somewhat with the development of manufacturing industries to larger proportions, and with the greater needs and greater wastes characteristic of larger cities; and I should regard the provision of 10 million gallons daily as sufficient to meet the city's needs for from ten to twelve years. A population of 75,000 will probably not be reached before 1912, possibly not before 1920. I think before these dates are reached extensions might be advisable.

As regards the pollution of the Susquehanna by sewage and surface washings, under the present conditions I think we may safely eliminate the Harrisburg sewage from consideration so far as the water supply is concerned. I have watched the river front carefully during low water stages, when heavy local rains were taxing the sewers severely, to see whether the discoloration of the river due to surface water extended out dangerously near the intake of the water works. This would be a pretty safe indication as to whether the sewage from the sewers above the water works was a source of danger, because at such times the river presents a very characteristic appearance. We find nearest the shore and extending out two or three hundred feet the dark brown water from the sewers; immediately beyond this is a stream of clear, bright Susquehanna River water, and still beyond this, for the remainder of the width of the river, the yellow water of the Canodoguinet Creek and Juniata River. At low water the velocity of the river is least, and during local heavy showers the force of discharge from the sewers greatest, so that at such times the discoloration from the sewers would extend out farthest from the shores. From my observations I could not see that there would be the slightest danger of contamination from the Harrisburg sewers. Possibly after a flood and with a falling river the sewage from far up the stream might be carried out to the intakes, but it would be so greatly diluted, and these conditions would prevail so short a time, that they could hardly be called a menace to the public health. I have made no chemical or bacteriological examinations of the water, because there are conditions under which such analyses would be difficult to interpret. The exercise of considerate judgment will demonstrate sufficiently well the points I wish to bring out.

THE RIVER'S COURSE.

The Susquehanna River, with the exception of the Saint Lawrence, is the largest stream emptying into the Atlantic Ocean on the Eastern coast of North America. Its watershed above Harrisburg is upward of 23,400 square miles. Its bed, however, is too steep to permit of continuous navigation. Just above the head of Chesapeake Bay there is a fall of about 80 feet in a distance of ten miles, and hence the velocity of the water is entirely too rapid to permit of the use of the stream for transportation purposes. This circumstance has been a principal factor in tending to preserve the purity of the water, because such a waterway, reaching as it does from the ocean into a country rich in mining products, would probably, if navigable, have been lined with cities during the days of water transportation, and its condition as to pollution would have been far worse than it now is.

The total population on the watershed above Harrisburg is now over two million people, 554,000 of which reside in the cities and towns immediately upon the banks of the river or its tributaries; of these, 500,000 live in cities or towns the sewage of which is discharged into the river in a crude state. These cities are as follows:

Name of City.	Population U. S. Census of 1900.	Kind of Sewerage System.	Distance by water above Harrisburg, Miles.
Binghamton,	39,647	Combined,	210
Elmira,	35,672	Combined,	200
†Sayre,	5,243	Partial Sanitary,	190
†Clearfield,	5,081	Partial,	190
Owego,	5,039	Combined,	185
†Philipsburg,	3,266	Sanitary and Storm,	185
†Emporium,	2,463	Sanitary,	175
†Wyalusing,	525	Sanitary and Storm,	160
†Meshoppen,	609	Partial Storm,	145
*Altoona,	38,973	Purification Works,	135
Carbondale,	13,536	Sanitary and Storm,	120
Dunmore,	12.583	Partial,	110
Scranton,	202,026	Combined,	105
Pittston,	12,556	(No data),	96
†Berwick,	3,916	Partial Storm,	92
Williamsport,	28,757	Sanitary and Storm,	90
†Huntingdon,	6,053	Has sewers,	90
Wilkesbarre,	51,721	Combined,	90
†Nanticoke,	12,116	Sanitary and Storm,	82
Mt. Carmel,	13,179	Partial,	75
†Bloomsburg,	6,170	Has sewers,	70
Shamokin,	18,202	Combined,	65
†Lewistown,	4,451	Some Private Sewers,	52
†Mifflintown,	953	Private sewers,	42
	522,739		

* Two-thirds of city's sewage not purified.

† Sewerage data from Manual of American Water Works.

It is seen from the foregoing table that there is undoubtedly considerable pollution. At extreme low water this pollution would be measured by a flow of 4.6 cubic feet per second to each 1,000 persons.

A SLOW CURRENT.

The average velocity of flow in the river at low-water stages is probably not less than one foot per second between Harrisburg and Binghamton, from which it may be seen that sewage from the latter place would reach Harrisburg in about 12 days. During heavy freshets the time would probably not exceed two days. Being in low stages a comparatively clear stream for a great part of the distance, and being well saturated with oxygen and nitrogenous food matter, the facilities for the transportation of pathogenic bacteria to considerable distances are better than in such streams as the Ohio and Mississippi Rivers, where the silt and clay in quiet stretches act as precipitating agents to carry the bacteria to the bottom where they probably cease to exist from lack of food supply or other necessary life conditions. That there is a disappearance of pollution in such streams is pretty well established, while in the Mohawk the pollution can be traced for many miles by the typhoid fever epidemics down the river; one notable case being the transmission of an epidemic from Rome to Albany, a distance of 125 miles, all the cities between, which took their water supply from the river, being visited one after another by the epidemic, with increasing violence, in about the time necessary for the disease to be incubated and transported from one city to the next. Bacterial and chemical analyses in this case gave no conclusive data, but the death rates in the cities affected, in consideration of attendant circumstances, established the facts very positively.

Since the bacillus of typhoid fever is very hardy, having been known to retain its virility for over 90 days in a cake of ice, it is not impossible for it to be carried from the source to the mouth of a river as long as the Mississippi, if it should find proper conditions for its nourishment.

The troublesome question in any particular case is to ascertain whether or not these conditions are more likely to favor its life than its death. This question at the present day must be answered with great reserve, judgment being formed in any particular case by comparison with other streams of a similar nature where observations have been made. For my part, I am inclined to believe that at low-water flow and at high-water flow the Susquehanna River water, so far as sewage pollution is concerned, is as good as the average surface waters of this country. At a moderate stage, say from three to five or six feet, I should be inclined to think that there would be considerable danger of the propagation of typhoid through the water, particularly in the early Fall, when the river makes its first rise after the summer season. It would be as unreasonable to state that the water is unfit to drink at any season as to say that it is perfectly safe at all times. It should be classed between these extremes, part of the time safe and the other part unsafe. I am aware that I am upon risky ground in making insinuations concerning the quality of a water so clear, bright and sparkling as that of the Susquehanna at Harrisburg for a considerable part of the year, but it must be remembered that clearness is only one qualification of good water.

A HIGH DEATH-RATE.

In large cities using impounded surface waters, such as New York, Brooklyn, Boston and Baltimore, the average annual typhoid fever death rate is about 30 per 100,000 of population. In those using polluted supplies, like Pittsburgh, Cincinnati, and Philadelphia, it may run up to 300 and over. In cities using pure supplies from large springs or ground water from great depths, like Vienna, Munich and Dresden, the typhoid fever death rate averages below 5 per 100,000 of population; in those using pure filtered supplies it eventually gets down to an average of six, in most cases. I have been unable to obtain satisfactory health records extending over a long period of time for the City of Harrisburg. I should expect to find considerable variation from year to year in the typhoid fever death rate—some years being as low as 30, or perhaps even less, and others where the figures would reach 100, or more, per 100,000 people. That is, as the population is about 50,000, I should expect to find from 15 or less to over 50 deaths per year from typhoid fever.

This is corroborated by the records of typhoid fever deaths published by the Sanitary Department for the fiscal years 1898, 1899 and 1900. We find the total deaths for these years, from typhoid, to be 14, 18 and 23 respectively, or, roughly, 28, 36 and 46 per 100,000 of population.

I have gone into this question with some fullness because information of this character is not as yet so widely disseminated in this country as it should be.

TYPHOID EVERYWHERE.

That bacteria may be carried down a stream for great distances there is no denying. It is a familiar fact, to all residents of this city, that the culm particles, which are very much heavier and larger than the bacilli, are brought down hundreds of miles; if these can be transported by the current there is no reason why the bacteria should not be brought down also. It is equally evident that they may be brought down in a living condition, as the time necessary for traversing the distance from Binghamton to Harrisburg may vary from about two days to two weeks.

OUR BEVERAGE—CLAY AND COAL!

The Susquehanna River water is of a peculiarly mixed character. The Canodoguinet Creek empties into the river about opposite Maclay street, while on the same side, and about 14 miles further up stream, the Juniata River joins the Susquehanna. The Canodoguinet and Juniata are generally turbid, while the main waters of the Susquehanna are usually clear, excepting during high water. Further up the river are many tributaries draining the coal mining regions, and these streams, after heavy rains, bring down enormous quantities of coal dust and culm. During the winter and spring months the river water becomes very turbid, and extremely objectionable from an aesthetic point of view.

At stationary low water there is no trouble from culm, and as a general thing the yellow water of the Juniata hugs the west shore of the river. During freshets, however, the culm that is brought down the river is thrown toward the banks when the river is rising, owing probably to the fact that the water surface is convex at such times, and the currents are oblique from the main channel toward the banks. When the river is falling after a heavy freshet there is a slight tendency for the culm to work back again toward the center of the river, as the water surface is then slightly concave. These phenomena account for the fact that often when the river is bringing down culm none will be found at the intake crib.

The best place for the intake would be between the east shore and the center of the river. Judging from such observations as I have been able to make the present intake is a little too far out; but the best point is difficult to locate because conditions are different at every flood, and probably the amount of improvement that could be obtained would not warrant the trouble and expense necessary to make a change.

FILTH IN RESERVOIR.

During the greater part of the time that I have been engaged on this report the Susquehanna River water has been clear and bright. Only twice has there been any trouble from culm, and I have not been able to see the water at its worst. Generally there is very little turbidity except during high and moderately high stages. In the summer months the water is quite clear and bright; but when the freshets come in the Spring and Fall, the enormous quantity of coal dust brought down from the mining districts renders the water so black and dirty that it is repulsive to sight and disagreeable for any purpose.

On two occasions the reservoir has been cleaned out; once in 1888 and again in 1894. On each of these occasions about 6,000 cubic yards of sediment were removed, consisting principally of culm. Were it not that a large amount of this culm was drawn off through the city taps by the consumers, probably the depth would have been much greater. Any improvement in the present water supply must have for one of its objects the removal of this turbidity. A water filthy in appearance, even though the dirt be not of a nature to endanger public health, is as objectionable from an aesthetic point of view as a polluted water.

STORING AND FILTRATION.

For the removal of turbidity two methods are practicable. One is simple sedimentation and the other is filtration. If the turbidity is of a kind that will permit of the water clarifying itself in a reasonable period of time simple sedimentation will suffice. Sometimes the addition of a little alum to the water as it enters the settling basins will effect clarification, but at times even this fails to produce satisfactory results, and then filtration must be resorted to. If the turbidity comes from clay it is very difficult to remove, because the particles of clay are very small, in fact are smaller than bacteria, and cannot be seen through microscopes of very high power. A process which will remove particles of this kind will, therefore, remove bacteria.

THE EFFECT OF THE DAM.

By the building of a dam across the river at Conoy street new conditions of flow are created in the channel of the river past the city. These changes will be felt only in times of low water or medium flows. At flows greater than those corresponding to a 10-foot rise the effect of the dam on the direction of the currents would be too slight to require consideration, because the average velocity of the stream would then be greater than at present when the water is down near the zero mark on the gauge. At minimum flows the dam will check the velocity down to about 0.4 ft. per second. This will have a tendency to allow the yellow water of the Juniata to crowd over near the intake, and the sewage from above the water house to work out further from the shore. I do not think, however, that it would work out 600 feet, even during the heaviest rain storms.

The calculation of the extremely flat slopes of the water surface at such times is a matter in which slight errors in assumption make serious differences in results, and I am not able, therefore, to say positively that sewage would not be carried out to the intakes when the river flow was light and the discharge of sewage very heavy. Should such be the case it would be advisable to extend the intakes about 4,000 feet further up the river, to get beyond the limits of sewage pollution.

The provision of an opening through the dam would tend to correct this trouble from sewage to a certain extent, by holding the main current near the shore line. The dam will not be the means of creating a nuisance.

FILTRATION.

In adapting a filtration scheme to the needs of Harrisburg, proper provision must be made for the settling of the coarser particles causing turbidity. In my judgment sufficient capacity should be provided for storing one day's supply of water. This will allow a period of 24 hours for sedimentation. Particles that will not settle out within this time can be more cheaply removed by filters than by allowing additional capacity for the reservoir.

There are two processes for the filtration of water on a large scale, the principal distinction between them being that in one process the water is passed slowly through large beds of sand, and natural agencies gradually bring the beds to such a condition that they are able to remove nearly all the bacteria and suspended matter in the water. Filters of this type are called slow filters, slow sand filters, English filters and natural filters. In the other type the water is passed rapidly through very much smaller beds of sand, a coagulant having first been added to the water for the purpose of supplying artificially a gelatinous film around and between the sand grains, in which to catch the bacteria and particles causing turbidity. These are called rapid filters, mechanical filters or

American filters. For the sake of brevity the two types will be called slow filters and rapid filters in the discussion which follows.

I have worked out in detail the estimates of cost for both the slow and rapid systems of filtration, and have assumed the character of the water to be the same in both cases, so that the estimates of cost are comparable; judgment based on comparisons of the two systems, therefore, would be affected in about the same proportion for either type of filter.

Either method of filtration, if properly carried out and correctly understood by those responsible for its operation, will purify a polluted water to a very high degree; but either will result in a failure if not properly carried out.*

RAPID FILTRATION RECOMMENDED.

Exhaustive tests covering long periods of time have shown that rapid filters can continuously remove nearly all the bacteria from the water. In some cases the degree of purification has equalled or exceeded that obtained by the slow filters. In others the rapid filter has been less satisfactory. For the Susquehanna at Harrisburg rapid filters will prove entirely satisfactory, both hygienically and for yielding clear water at all times.

Objections are sometimes made by physicians that the use of alum in the water in connection with rapid filters is dangerous to health. I have never been able to secure the slightest evidence that this is so. The fact is that alum in such small doses as are used in water filtration, is not only dissolved in the water, but it decomposes, forming the harmless hydrate and the sulphates of the lime and magnesia that were dissolved in the natural water. There is thus no alum and no acid in the water after filtration.

I would not recommend a plant of this kind for Harrisburg without insisting that a competent chemist and bacteriologist be permanently employed to make daily tests and prescribe the proper manner of working the plant. No concern would undertake to conduct its business without experienced heads for the various departments. For the same reason no water purification plant can be operated without the proper supervision of all the details necessary to ensure success. In all the estimates of cost of filtration, therefore, I have included the salaries of the necessary operatives from the chemist to the laborers.

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* NOTE.—Full details as to both methods of filtration are found in the complete report.

Filtered water is generally, though not always, very rich in the elements necessary to foster plant life. Therefore, when it is left exposed to the outer air and to light, growths of algae and water bacteria are likely to develop quickly and grow luxuriantly. It is, therefore, generally the custom to store filtered water in dark or covered reservoirs to prevent such deterioration. Some waters, however, do not seem to be so bad in this respect as others.

The question has been raised as to the advisability of moving the present water works plant further up the river, beyond the city limits. This would be entirely unwarrantable. If it were desirable to secure a better point for the abstraction of the water, it would be cheaper to extend the intakes up the river than to move the whole plant, and lay a pipe down to the city again to connect with the city water mains.

The only object in changing the intakes would be to avoid sewage pollution. With properly designed and operated filters this point has no weight in Harrisburg. The whole river is polluted—it is only a question of degree, and this varies with the condition of the flow in the river.

The filters of Altona, Germany, furnish a striking example of the power of properly operated filters to remove disease-producing germs from water. Hamburg, a city of nearly a million people, lies up stream from Altona on the same side of the River Elbe. All the sewage from Hamburg empties into the Elbe above Altona, and within a short distance of the intake of the latter city's water works, yet the filters have for years removed all the impurities from the water and prevented the outbreaks of epidemics of water-borne diseases. One notable instance was in 1892, when Hamburg used the unfiltered water from the Elbe. In that year the stream had been polluted by the dejecta of cholera patients; a few days later an extremely severe epidemic of cholera broke out in Hamburg, while Altona, using the same water polluted in addition by the Hamburg sewage, but filtered, escaped almost entirely. The few cases which occurred in Altona were generally traceable to the drinking of the Hamburg water.

I recommend that the city establish a rapid filter plant of a daily capacity of 10 million gallons, using the present reservoir for sedimentation purposes, and building a new 7½ million gallon reservoir for filtered water, near the site of the filters.

Following is a more detailed statement of the items making up the cost of construction and of operation of the plan recommended:

COST OF CONSTRUCTION.

Land and right of way	$15,400.00
Covered rapid filters, including piping, valves, buildings, pumping machinery, chemical apparatus, laboratory, air compressors, motive power, lighting plants, tools, fixtures, etc.	94,000.00
Residences, shelters, grading, fencing, etc.	20,900.00
Auxiliary low-lift pumping station and machinery,	29,600.00
Force mains and return pipe from present reservoir to works, exclusive of right of way, which is included above	50,600.00
Covered filtered water reservoir	68,500.00
Total	$279,000.00

ANNUAL COST OF OPERATION AND MAINTENANCE.

*Interest on $279,000 at 3½ per cent.		$9,765.00
Depreciation		2,490.00
Auxiliary pumping,		3,943.00
Filtering Water:		
Superintendence and labor, including salary of chemist	$8,090.00	
Chemicals,	10,100.00	
Fuel	1,885.00	20,075.00
Total		$36,273.00

When studying water purification for cities it is generally advisable to examine the pipe lines for distributing the water through the city, to ascertain whether or not conditions exist which would be a factor in the deterioration of the water. In the Harrisburg system of distribution I find little to criticise. Generally the mains are of ample size. There are a few dead ends that should be connected in order to allow proper circulation of the water, because at such places the water is likely to stagnate, with resulting disagreeable tastes and odors.

THE IMPROVEMENT OF THE SEWERAGE.

At the present time the City of Harrisburg is quite completely sewered. The system generally adopted is what is commonly known as the combined system. That is, the sewers receive the

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*This interest charge is included in the calculation on page 3. Under the conceded conservative management of the Harrisburg Water Department, it is certain that this maximum estimate of the cost of maintenance will be very greatly reduced.—Committee.

contents of the house drains, as well as the surface water from the roofs, yards and streets.

Topographically, the city may be described as being made up of two distinct parts: The valley of Paxton Creek, and that part of the city draining naturally into the Susquehanna River. With one or two exceptions, all that part of the city lying east of Sixth street and Fourth street from the north line of the city to Walnut street, and east of Third street from Walnut to Mulberry street, drains naturally to Paxton Creek, while the part lying west of this dividing line drains to the Susquehanna River. A general plan of the city showing the existing and proposed sewers, is included in this pamphlet.

To ascertain what improvements would be desirable, careful calculations were made to test the sizes of the sewers as to their capacity to remove the greatest amount of sewage and storm water that might be expected to reach them at the present time and in the future when the paving of streets and the erection of larger buildings would increase the amount of impervious surface in the respective districts. Each main sewer, together with its tributary branches, was gone over carefully, and all but a few were found to be of ample size. The exceptions will be noted at a later point.

NO POLLUTION OF THE CREEK.

As has been stated, it will be necessary to intercept the dry-weather flow of the sewage going toward Paxton Creek in order to prevent the pollution of that stream; therefore, in that part of the city lying on the hill east of the creek it would be economical to adopt the separate system for future sewerage facilities, taking all the house sewage down to the intercepting sewer along Paxton Creek, and building independent drains for the storm water leading by the shortest lines to the nearest stream. This will be much cheaper in the end than to take these streams into the sewers, and will prevent the streams from becoming nuisances. If the combined system is adopted it will soon become necessary to build a large sewer down Haehnlens Run, as its bed will become very foul and a menace to public health if the house sewage is discharged into it. The same remark will apply with equal force to Asylum Run, when the territory tributary to it becomes an available residential section. For the rest of the city, that is the portion draining toward the Susquehanna, the combined system is the better and the more economical.

Summing up, I would recommend the combined system for the territory draining toward the Susquehanna River, and the separate system for all future extensions in the territory draining to Paxton Creek from the hills on the east side of the valley. For the part of the city west of, but draining into Paxton Creek, I would recommend the combination system, the sewers to be so arranged that the dry-weather flow would go into the intercepting sewer and the storm water would overflow into Paxton Creek.

SEWER DEFECTS.

In many of the old sewers there are radical defects which should be remedied as opportunity offers. Most of the old sewers are without manholes, and in some cases ventilation is impossible, during high water in the river, except by the blowing of the traps in the houses. I am informed, also, that in many cases, cellars are drained into these sewers with pipes without traps. In most cases the house drains are trapped, but nearly all the down-spouts from the roofs connect with these drains on the sewer side of the trap, thus venting the sewer through the rain pipes. This practice is not so bad as to warrant an entire change in the system, when the down-spouts are of cast iron with tight joints, or of copper with soldered joints; but as most of those in use are of tin or galvanized iron they soon become rusted out, and permit the sewer air to escape near the windows so that it may be blown into the rooms of the adjacent buildings.

There are some questions in dispute concerning the proper manner of ventilating sewers, but on the main point, that is that ventilation should be provided, there is no difference of opinion. The disputed points concern methods and amounts. To some, ventilation means that the air in the sewer should be replaced frequently by fresh air; to others that small vents only need be provided, in order that the water may not be sucked out of the traps on the fixtures in the houses when the water level in the sewer rises or falls. I have seen both methods operating successfully, and have recommended the method which offered the most advantages in the particular case under consideration.

At Harrisburg most of the sewers discharge below the level of the water in the river or in the creek, so that their mouths are sealed against the ingress or egress of air for most of the year.

Now if there are no manholes and if all the street inlets, drains and fixtures are trapped, the sewer air forced out by a rising flow in the sewer can escape only by such pipes as are untrapped. If these happen to be connections for draining cellars the air will be forced through them, and will permeate the whole house.

If they happen to be rain spouts the air will escape above the roofs if the pipes are tight, or partly out of the top and partly out of the holes if the pipes are rusted out.

MANHOLES NEEDED.

As a matter of public safety, plumbing regulations should be adopted by the city, and enforced by the sanitary and building inspectors. These regulations should prohibit the venting of sewers through down-spouts, unless the latter are of cast-iron with leaded and caulked joints, or of copper with soldered joints. As opportunities offer, manholes having perforated covers should be built on the old sewers, so that there could be no suction nor back pressure on the traps on the house drains. In very narrow streets and avenues, instead of perforated covers on the manholes, I should prefer tight covers and that there be provided cast-iron vent pipes leading from the respective sewers to the tops of nearby houses.

The questions concerning the proper treatment of the sewer outfalls are discussed beyond.

Taking up now the plan proposed for relief, where trouble might be expected, we find that there are three bad conditions to be rectified: (1) Those due to insufficient capacity; (2) Those due to the sewers being too near the surface, and (3) those due to the poor condition of the sewers.

Considering first those defects due to insufficient capacity, I find that trouble is to be expected at the following points: At Verbeke and Capital streets; at the junction of Wood and Delaware avenues; at Seventh and Calder streets; Cumberland street at Wallace and at Currant avenues; North street at Cowden street; Second street and Washington street; Market street at Thirteenth and Fourteenth streets, and in the territory lying between State and Walnut, Fourth street and the Pennsylvania Railroad. These places are all subject to congestion during a heavy fall of rain. The trouble may not be apparent at the surface, and gutter water may run in without difficulty, but owing to flat grades or small sizes the present sewers are not large enough to take off this water without running under pretty high heads in some cases, and ruptured sewers or flooded cellars may follow as a consequence.

Unsatisfactory sewerage due to sewers being too shallow is to be found at several places. To remedy this trouble I would recommend the construction of new and deeper sewers of small sizes, but sufficiently large to take the house sewage alone, on the streets where trouble has been experienced. All the house sewers and cellar drains should then be disconnected from the old sewers and connected in a proper manner to the new system.

In the estimates of cost for the new sewers allowances have been made to cover the cost of making these connections anew in a proper manner. The estimates also include the necessary flush-tanks, manholes and outfalls for all new sewers. In all those districts where troubles arise on account of shallow sewers, there need be no changes so far as street inlets are concerned, as the old sewers can still be retained without changes for the removal of the surface water.

In South Harrisburg where considerable trouble is now experienced, relief will be had by laying a few small deeper sewers for house connections only, discharging into the new intercepting sewer passing through Tuscarora street. The street water would still flow into the old sewers.

All the sewers in the district between State and Walnut streets, Third street and the railroad yards, are in such poor condition that their reconstruction and the remodeling of the house connections in a proper manner are very necessary.

After the construction of the dam below Conoy street, the ends of the outlets of most of the sewers will be sufficiently far out from the edge of the water to prevent the stranding of the sewage matter along the shores. A few will need lengthening. The outlet of the interceptor at Tuscarora street will be extended out beyond the opening through the dam, so that at all times the sewage will be washed out toward the middle of the river by the rapid stream of water flowing through the opening.

The Tuscarora street sewer will terminate at the bank of the river in a retaining wall, with wing walls running out to the slopes and a paved bottom extending between these wings to the low-water mark. A tide gate will be hung over the mouth of the sewer to prevent the entrance of rats and other animals and of silt from the river during floods. It will also prevent the escape of air from the sewer at the river front. A 36-inch pipe will leave the sewer behind this tide gate, and will convey the dry-weather sewage out beyond the opening in the dam. Heavy flows of water, due to rains, will overflow and run out over the paved bottom of the river.

CELLAR DRAINAGE.

In carrying out new works for sewerage there are a few points to which attention should be called. First in importance, perhaps, is the method of getting rid of cellar drainage. The present practice is to run a pipe from the cellar to the sewer, sometimes putting on a trap and sometimes omitting it. This construction is radically wrong for the following reason.

There is during dry-weather flow no water running through this pipe, and eventually the water in the trap will evaporate and the sewer will be vented into the cellar. If there is no trap the sewer air will be continually entering the cellar whenever the water level rises in the sewer.

The same criticism applies to rain leaders, as has already been noted. I have not a great deal of faith in the so-called mechanical traps for such places, because they are apt to fail if pieces of wood or rags become lodged therein. The only safe way is to disconnect these pipes into a manhole so that ventilation into the cellar will be impossible.* It will be seen that as traps on the house sewer will be kept filled so long as the house is inhabited, air from the sewers cannot get back into the manhole, nor into the house pipe past the main traps. Therefore the cellar is secure against sewer air, even though the trap on the cellar drain pipe should go dry. There will be no escape of gases into the manhole from the surface of the water running through it, because the sewage will be fresh, and there will be little or no putrefactive change. Down-spouts should be connected to the sewer in the same way.

Wherever new sewers have been provided for in the subjoined estimates, the cost of making the connections for all the houses in the district have been included.

The estimates of cost of the different sewers recommended are appended. As has been already stated, the cost of connecting the existing sewers and the proposed sewers with the interceptor along Paxton Creek is included in the cost of the interceptor.

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* NOTE.—In the complete report, and in the large original maps (on exhibition at 120 Market street), elaborate detail drawings are provided for sewer connections.

COST OF CONSTRUCTION OF NEW SEWERS RECOMMENDED FOR THE IMPROVEMENT OF THE SEWERAGE SYSTEM.

COMBINED SEWERS.

Verbeke street, Capital to Third street, with manholes, complete	$1,020.00
Fifth street, Muench to Delaware avenue, and Delaware avenue, Fifth to Wood avenue, including manholes and catch basins, complete	888.00
Verbeke street, Wallace avenue to Paxton Creek, and Seventh street, Calder street and Verbeke street, including manholes and junction with interceptor, complete	12,021.60
Front street, Briggs to Liberty avenue, and thence to the river including manholes and catch basins, complete	1,987.80
North street, Cowden street to Canal (Canal to Paxton Creek included in cost of interceptor), including manholes and connecting catch basins to sewer	3,336.00
Sewers for district between State and Walnut, Third street and R. R. yards, including manholes, reconnecting catch basins and remodeling house connections, complete	14,835.00
Washington street and Second street to river, including manholes, reconnecting catch basins and remodeling house connections, complete	3,780.00
Fourteenth street, State to Walnut, including manholes and connections with sewers on State and Walnut streets, complete	1,344.00
Market street, Fourteenth to Evergreen, including manholes and reconnecting catch basins, complete	4,176.00
Total	$43,388.40

SEPARATE SEWERS.

For the district between Second street and the river, between Barbara avenue and Locust street, including manholes, flush tanks and remodeling house connections, complete	$16,790.00
Between Market street and Blackberry avenue, and Market Square and the river, including manholes, flush tanks and remodeling house connections, complete	3,060.00
Race street, Paxton to Hanna and Indian alley, including manholes, flush tanks and remodeling house connections, complete.	6,222.00
Third street, Blackberry avenue to Meadow Lane, Meadow Lane, Third to Second street, Court avenue, Mulberry to Meadow Lane, and Second street, Mulberry to Washington street, including manholes, flush tanks and remodeling house connections, complete	4,896.00
Amount forward	$30,968 00

Amount brought forward	$30,968 00
Cowden avenue, Boas to North street, including manholes, flush tanks and remodeling house connections, complete	2,900.00
Total	$33,868.00

SUMMARY.

Total cost of combined sewers,	$43,388.40
Total cost of separate sewers	33,868.00
Total cost of new sewers recommended	$77,256.40

THE IMPROVEMENT OF THE SANITARY CONDITION OF THE SUSQUEHANNA RIVER.

The river front should be the pride of every citizen of Harrisburg, as there are few cities which are situated so favorably in this respect. Usually the river fronts are usurped by manufacturing and industrial interests, and all possibilities for pleasure and recreation along the water are sacrificed for the benefit of industries comparatively few in number.

In Harrisburg nothing stands in the way of making the river front one of the most attractive promenades in the country, except the fact that at times of low water the decomposition of organic matter along the shores gives rise to odors that are disagreeable and offensive. There is in addition to this offensiveness a danger lurking in the pollution, a danger which may affect the general health of the city by giving rise to malarial and intestinal diseases. The pollution comes from several sources and is aggravated by the character of the river bottom. Generally speaking the bottom is flat and the banks rise steeply up to the level of Front street.

As the water surface falls during the late summer, quite large areas are exposed at the foot of the steep banks. These become coated with greasy matter from the sewers, particularly just below the mouths of the latter, and the odors arising from the decomposition of this matter are extremely unpleasant.

Another source of the disagreeable odors, aside from the city sewage, will be found in several private sewers from houses along Front street. Many of these sewers do not extend to the water, but discharge on the banks. This should be discontinued at once, or the sewers extended out below low-water mark. On the west side of Front street, from Herr to Calder street, there is a row of buildings the outhouses from some of which are on the edge of the high bank of the river. Some of the houses have sewers, but these extend only to the edge of the river bank. These nuisances should be summarily abated by the laying of small sewers back of the properties and leading to one of the large sewers nearby, and by the enforcement of ordinances requiring the use of water closets and the abandonment of privies.

BAD SMELLS.

Aside from this sort of pollution, there is another source of disagreeable odors arising from natural conditions, and which may be equally dangerous as far as spreading malarial affection is concerned. Owing to the great width of the river, which averages about 3,300 feet where it flows past the city, and owing to the small flow during summer months, large areas of the river bed are exposed at times. The irregularity of the rocky bottom affords opportunities for the stagnation of water in pools of greater or less area, and these form favorable places for the breeding of mosquitoes, the general medium for the transmission of malaria.

The corrective measures for these evils are simple.

In the first place let us inquire into the question of how much sewage the river may safely receive. The minimum flow of the river, from the best data I have been able to obtain, is about 2,300 cubic feet per second. This amount of flowing water, if the sewage could be properly dispersed through it, would safely receive the sewage of 700,000 people. The pollution coming from cities above, while considerable in amount, as has already been shown on page 39, need not be considered as a factor in the disposal of the sewage of Harrisburg. We see, therefore, that provided the sewage is properly discharged into the river, it will cause no offense whatever. The limits to which pollution may be carried without making the water offensive are pretty well known from the records of many cities in the United States and Europe.

There is (see Table) no question but that the river can take the Harrisburg sewage if it is discharged into the current in a suitable manner. The requirements are that a considerable quantity of water should flow between the ends of the sewers and the shores, at low water. When this condition is fulfilled there will be no trouble from the sewers, because the sewage will be diluted, and will be prevented from being washed ashore to decompose under the influence of the sun and the action of putrefactive bacteria.

These observations summarized may be stated as follows:

Flow of stream in cubic feet per second per 1,000 persons discharging sewage into it.	*Condition.*
Less than 2	The water will certainly become offensive.
2½	A nuisance may or may not result, according to local circumstances.
3	The water would probably not become offensive.
3½ to 4	Generally safe.
6 and more	No danger of offensiveness.

EXTEND THE PIPES.

There is in some places, however, a difficulty in carrying out this policy, because of the shallowness of the river. It will be necessary not only to extend the sewers but also to place the pipes down in an excavated trench, so that the water may flow over them. If they were laid on the bottom without any excavation, they would have to be protected by piles of stone to hold them in place, and as these piles would simply be obstructions at low water, behind which the sewage would be carried by eddies and currents, the conditions would eventually become worse than they now are. It would not be necessary to carry them out of full size, however, because only the dry-weather flow of the sewage would have to be taken out from the shores. During rains the sewage would be so diluted with rain water that its occasional discharge at the present outlets would not be offensive. Small pipes extended from the present outfalls, with overflows to permit the escape of rain water, would rectify the troubles from sewage pollution of the shores by the city sewers.

THE PROPOSED DAM.

All the difficulties regarding the sewage pollution of the shores and the exposing of the river bottom may be overcome, however, by building a low dam across the river near the south end of the city. I have found a suitable site for such a dam below the Philadelphia & Reading R. R. bridge. The location is shown on Plate.

Along the line of this dam the river bottom is a bed of limestone, and is nearly level. The proposed site below the railroad bridges was selected because of the possibility of the formation of ice blockades, which might endanger the railroad bridges should the dam be placed above them.

IT COVERS THE FLATS.

To establish the proper height for the dam and its effect on the surface heights of the water, a careful survey was made to ascertain the present slope of the water surface at a medium low stage.

I find that the economical height would be about 4½ feet above the average river bottom, or the elevation of the crest would be 291.9 feet above sea level. A dam of this height would cause comparatively quiet water as far up as Maclay street. At Maclay street there is quite a rapid fall in the river bottom, and to throw the water, during extremely dry weather, further up than Maclay street would require a dam of considerable height.

At the height selected all the flats would be permanently submerged from the dam above Maclay street. This would relieve the present bad condition during dry weather.

It would also permanently cover the low flat shores along the water edge on the Harrisburg side, and would solve the question of the pollution of the shores by covering the ends of the city sewers, and allowing a current of clean river water to flow between them and the main shore line.

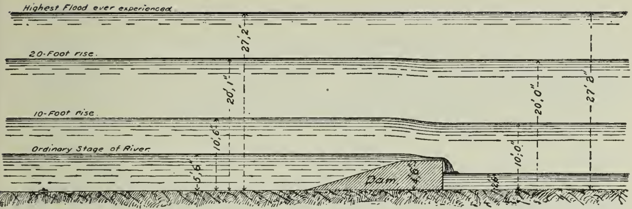
Some of the outfalls would have to be extended by the addition of a few lengths of pipe. These should be of the same sizes as the present outfall pipes, and no overflows would have to be provided, as would be the case if the dam were not built.

AN INTERCEPTING SEWER IMPOSSIBLE.

It would not be necessary to build an intercepting sewer along the river bank, to take the sewage below the dam. In fact it would be impossible to maintain such a sewer, because the available slope is so slight that the sewers would soon fill up with deposits, and would become a worse nuisance and more potent source of danger than now exist. The effect of the discharge of the sewage into the pool formed by the dam will not be more injurious upon the character of the water than if the dam were not built, because there will always be a perceptible current along the river shore, even during periods of driest weather. At the ordinary low summer flow, say about 5,000 cubic feet per second, the mean velocity through the reservoir will be a little less than ½ ft. per second. With a quantity of flow corresponding to the ordinary small summer rises, say about a 2½-foot rise, the water would flow over the dam about a foot deep, and the mean velocity through the reservoir would be about a foot and a half per second. It will thus be readily appreciated that there can be no stagnation in the pool formed by the dam. At higher stages of the river the velocity increases, being over 2 feet per second when passing a quantity of water corresponding to a 4-ft. rise, and reaching 8 feet per second during the big floods. It will be desirable, however, to provide openings through the dam near either shore of the river, with a combined area sufficient to discharge the minimum flow of the river, while holding the surface of the water in the pool level with the crest of the dam. The opening on the west end of the dam would have a tendency to draw the yellow water of the Juniata River and Canodoguinet Creek to the farther side of the pool, while the opening through the east end of the dam would draw the principal current along the shore line in front of the city, and have a tendency to draw fresh water between the sewer outfalls and the bank, as well as to keep the water in which the sewers discharge in continuous motion. It will be unnecessary to provide movable sections in the dam, because there will be very little tendency for the pool to silt up. At times of the year when the river carries much sediment in suspension it is at a fairly high stage, and the velocity through the pool will be sufficient to carry the suspended matter over the dam. During heavy freshets, any matter which may have been left by the tail ends of the small floods while the river was falling would be picked up and washed out much the same as now occurs.

THE DAM WOULD NOT CAUSE FLOODS.

The effect of the dam on the heights of the floods will be insignificant. Thus with a quantity of water corresponding to a 4-foot rise the dam will raise the water level to the 7-foot mark on the gauge. When the water rises to a height of about 4½ feet above the top of the dam, the increased slope necessary to discharge the water through the reduced area over the top of the dam will amount to only a few inches, and with greater floods the effect of the dam will not be noticeable. As a general thing when water flows over a submerged dam with a depth equal to the height of



CALCULATED DEPTHS OF FLOW OVER DAM.
Length of Dam, 3300 feet.

the dam, the surface of the water will give no indication that a dam exists. It is therefore readily seen that this low dam will have no effect whatever on the heights of destructive floods. When the river is high enough to go over the large valuable islands, the flood heights will not be raised by the dam by so much as half an inch above the normal.

In other words, the flood conditions will be the same as if there were no dam across the river.

I have designed for this dam a structure of steel and concrete on the Ransome system. I have chosen this form of construction because of the security it offers, and the ease and cheapness with which the dam may be built.

There is no question concerning the stability and durability of a structure such as is proposed. Where steel bars are thoroughly embedded in a rich Portland cement concrete, they are perfectly protected against rust and will last practically forever.

COST.

The dam proposed, built across the river at Conoy street, with some of the sewers extended further into the river channel, would cost, complete, $55,000.

NO LEGAL DIFFICULTY.

I am informed that the building of the dam by the city would interfere with no rights of navigation or business, as parties now removing culm and sand from the river do so by permission, and have no rights paramount to those of the general public. It would therefore be unnecessary to provide a lock for the passage of boats. Such a lock could be built, however, if desirable, but I have not added its cost into that of the project.

REPORT ON A PARK SYSTEM FOR HARRISBURG, PENNSYLVANIA.

The study for the development of a system of public reservations and the general improvement of Harrisburg has included the appearances of the city as a whole, because attractive outlooks and agreeable surroundings are quite as important in the daily walks of life as the complete change of scene which the more inaccessible country park offers.

CONTROL OF PARKS.

In acquiring and developing a great public park having all the elements of a beautiful landscape, a city is creating and preserving a gallery of living pictures. Whether these pictures are to grow continuously in beauty from year to year and from century to century, or be disfigured or seriously injured, is wholly dependent upon the original design of the system and its future maintainance. A park designer must not only have the ability to perceive the greatest beauty that lies within the crude landscape, just as a sculptor sees the beauty in his crude stone, but also the technical knowledge to carve it out, or make it grow up to his ideal. He must provide at all times for all the requirements of the public in such a manner as to not defeat the main purpose. These pictures are alive, and to grow in beauty they must be cared for by persons who are in sympathy with the motives of the designer and whose term of office and that of his principal assistants is a permanent one.

HARRISBURG'S LANDSCAPE FEATURES.

The dominating landscape features of the city proper are the river, where a mile of frontage controls five or more hundred acres of open space, which is in itself an ever changing, always beautiful landscape and the high tree-covered bluffs of the Paxton Creek valley, with its fringe of trees. Stand upon Mulberry or State street viaducts and look over this valley, and imagine the bluffs, now covered with foliage, reduced in apparent height from thirty to sixty feet by the removal of the trees, the denuded slopes scarred with raw gullies and defiled with rubbish. Look again at the masses of fine foliage along the banks of Paxton Creek.

It would be a public calamity if all this luxuriant greenness was to be swept away, exposing the back-yards of hundreds of dwellings, and destroying the shade and verdure from which the occupants of these homes gain so much.

The most important landscape feature outside of, and near the city limits, is the entire ridge upon which the City Reservoir Park, the only present summer playground of the people, is located. From its natural summit, on "Cherry Hill," the highest point near the city, east of the present Reservoir Park, there is a fine panorama of the distant mountains, the river, the town and the ridge. Three groups of forest trees crowning the ridge are conspicuous and attractive objects in view from many places in the city and valley.

The only practicable park of any extent at present controlled by the city is Reservoir Park, which is incidental to the water supply. It is situated upon the ridge before mentioned, of which it includes a small part of one slope only. It should be extended to include the whole summit of the ridge and about one-half of the northerly slope, down to a point where a plantation would shut out the immediate foreground of houses in the valley, but not the fine mountain range beyond or the river in the distance. The southerly slope should be included down to Market street, to connect with the proposed filtration plant which may properly be a part of the park system.

There is a great need of more room at Reservoir Park to adequately accommodate the constantly increasing number of visitors, to provide more varied amusement, and to establish interesting and instructive plantations. With all additions and improvements this park, however, must continue to be a holiday park for occasional enjoyment, not an everyday playground for the many, as it is too far from the crowded portions of the city.

After careful consideration of the wonderfully beautiful and favorable natural situation of the city of Harrisburg, as briefly noted above, and in connection with its importance as the Capital City of the second State in the Union, and as a notable railroad center, I have prepared the accompanying plan, which is submitted to your Committee as a suggestion for a park system. The plan shows all existing ornamental features as well as the proposed takings for park purposes in general.

I most earnestly urge the acquirement by the city at the earliest possible date of as much of the suggested area as can be obtained within the city's financial resources, for it is obvious that with the present rapid increase in population, the natural rise in value of suitable territory will soon make its acquirement very expensive.

The plan embraces a series of small playgrounds and parks, so suitable as to be accessible to the great mass of your much congested population. These parks and playgrounds are proposed to be connected by a simple system of parkways and paths, the acquisition and development of which I believe to be entirely practicable and in the highest degree economical from the standpoint of the city's welfare and advancement.

The detailed plan submitted is believed to be quite accurate, having been based for the most part upon my own surveys, made for the purpose.

With this introduction, I pass to the recommendations in detail.

RECOMMENDATIONS.

The city should acquire as much of the river frontage as possible, the smaller islands in the river, including the easterly shore and two ends of Hargest or Forster's island, the wooded bluffs of Paxton Creek valley, and in addition to what it now controls, enough more of the banks of Paxton Creek to preserve the trees. All of this land is of little value for agricultural or commercial purposes, whereas its value as an element of beauty in the city limits is beyond price, for if destroyed no money could replace it.

SMALL BREATHING SPACES.

Upon such lands many pleasantly shaded, small play-grounds could be established at such frequent intervals that the children could use them daily instead of being compelled to play in the streets or upon the sewer-polluted shores of the river. Furthermore these reservations make part of a system of shady roads and paths connecting the various larger parks as proposed. It is recommended also that play-grounds be established upon school and church properties, especially in sections of the city somewhat removed from the proposed reservations, or where the land values are high.

Within the city limits one or more small parks should be established within easy walking distance of the homes of citizens who have no means for driving, and cannot well afford the frequent use of the trolley. Such reservations should have attractive landscapes, quiet walks, and resting places where nervous and tired people, the sick, and mothers with their children can secure a complete change of scene, freedom from noise, boisterous games, and the constant passing of people.

The State Capitol grounds could be so arranged as to serve this purpose admirably for the northern section of the city, and at the same time give the great building under construction a proper setting. In the southern section the George F. Mish property, between Paxton and Cameron streets, and a wooded creek-valley below it, form an ideal site with a fine view from its summit, fine trees surrounding it, and rich soil.

WETZEL'S SWAMP—THE GREAT COUNTRY PARK.

Every growing city has acquired, or should have, one or more large country parks where broad reaches of landscape may be held for all time for the benefit of the people. Such parks can be acquired only at a time when land can be secured at a low cost, and they must necessarily lie outside of the thickly settled portions of the city. When the city grows to and about them, the full value of the investment is realized.

The opportunity for a great country park at Harrisburg lies to the north of the city in the tract known as Wetzel's Swamp, which includes about five hundred acres of swampy and dry land, framed in with wooded bluffs on the one side and a line of fine old willows along the canal on the other. As it stands today it is a natural park, with beautiful passages of landscape and fine vistas over great stretches of meadow land to distant hills beyond. It is rare, indeed, that a city can secure a property having at the outset all the elements of a park landscape, including its border-planting, its groups of fine trees, with splendid individual specimens, and its woodlands, carpeted in spring with numerous wild flowers.

Here also there is a comparatively level and perfectly dry upland, that, with but little clearing, and the removal of pens and sheds can be made available for picnics and games. In the meadows masses of brilliantly colored flowering plants, which the uplands cannot produce, are found, giving color and effect at different seasons of the year. This region is quite accessible by steam and electric cars, and there are roads at several points across the meadow, and for a long distance along the boundaries. The swampy condition which prevails upon much of this land, can be remedied, for there is abundant fall for all drainage through Fox's Run and Paxton Creek.

INTERIOR WALKS AND DRIVES.

Many citizens who most need the outing, will not go to the public reservations over narrow thoroughfares crowded with business traffic. Harrisburg is again fortunate in having several streets sufficiently broad to be given the character of a parkway, with turf, planting spaces, and uniform rows of trees. It might be mentioned here that the successful planting of trees along all city streets, as well as along park approaches, can best be done by a park or other commission rather than by individual property owners.

As Paxton street connects with a proposed parkway taking at the suggested small park, here there will be an opportunity to improve the street grade. From here it passes along the railroad bank, taking advantage of existing bridges, thence up the valley by a fine grove of trees, to a great circle at a junction with Market street and the park. The proposed parkway continues from a similar circle at State street and the park, along the valley back of the Arsenal, thence along the Asylum Creek slope, where it will be so screened by trees on the bluff as to be shut out from all view of the Asylum buildings.

Through the bluff taking west of Paxton Creek, a road connection can be provided between State and Maclay streets, but from State to Paxton streets hardly more than paths and small playgrounds can be provided.

THE MAGNIFICENT RIVER FRONT.

Quite as important as any of the thoroughfares referred to is Front street, which bounds the great landscape of the river that will be greatly improved if the dam, referred to in Mr. Fuertes' report, is built to keep the water from falling below a fixed level. Here also is the opportunity to establish a splendid esplanade, with gardens, playgrounds, promenades, and colonnades; however, this must be the work of the future, or the monument of some generous citizen. Some work, nevertheless, should be done along the water front to give the banks and streets a more finished appearance than they now have. The trees should be thinned and trimmed, and a good turf established. A clearly defined promenade should be made along the top of the bluff, with occasional cross-walks, and a hedge planted along the top of the bluff to separate the finished condition of the street from the wilder covering of trees and shrubs upon the slopes. This will greatly improve the appearance of the street, and the expense will be so small that the adjoining property owners might well afford to undertake it.

The existing growth upon the banks should be encouraged and protected, for with a little judicious removal of the undesirable growth that shuts out the view, it will be quite as satisfactory and much more secure than any artificial planting could be made.

CONSTRUCTION.

The city does not need, and cannot afford, now, during the acquirement of land, broad parkways with several roads and paths through its reservations. It should at first provide very simple and inexpensive roads and paths, which, however, should be very carefully studied in regard to location and grade, in order that everything done will tend towards the completion of a definite plan. Without a study of detail plans, work is sure to be done that must be undone or remain unsatisfactory, especially where the margin for variation is small, as in some of the proposed takings. Above all else, the mistake of clearing out the undergrowth in woods, or the shrubs in fields and along walls, should be avoided.

What has been said regarding the desirability of opening reservations promptly to the public by simple means, applies with even greater force to playgrounds. A very simple and inexpensive equipment will appeal to the children quite as much as more highly furnished appliances. The plan I suggest provides a place for such grounds at the bluffs, and along the river shores, and it is further suggested that church and school grounds, especially in thickly settled districts, be opened to the children.

The educational value of parks must not be overlooked. In Wetzel's Swamp the native animals and birds could be introduced, protected and studied. The native flora of the entire system is a rich and interesting one, and the various species of plants could be designated for the benefit of students. In the artificial plantations required at Reservoir Park all exotics in common cultivation could be introduced in such a way as to be of real educational value.

ACREAGE AND COST.

The entire plan submitted shows within the city limits takings which, together with the Reservoir Park additions, would include one-tenth of the total acreage, of the city proper. This would provide, with the suburban population about Reservoir Park excluded, about one and one-fifth acres per 200 people. With the addition of Wetzel's Swamp there would be one acre to sixty-five population, but here again we exclude the population beyond the city limits. With this same exclusion the cost per capita would be about ten dollars.

Nine hundred and twenty-nine acres are suggested for addition to the park system, with an assessed value of $308,000, this being 60 per cent. of the real value.

The estimated cost of inexpensive roads, paths, drainage and bridges, to open up reservations and equip playgrounds, brings the amount for carrying out the entire plan to $550,000. The population of the city is 50,000, as against about 39,000 in 1890, and the city's area is about 3.00 acres, within which, and including Reservoir Park, the plan shows takings of 300 acres, the other additions suggested being outside the present city limits.

The estimated cost is believed to be high. It includes a portion of the Asylum and Arsenal property, which presumably, could be secured from the State, also river frontage, some of which, we are led to believe, will be transferred to the city. The assessors in the Wetzel Swamp district make no distinction between the upland and the swamp. Here the estimate is based upon the average values of whole farms. Furthermore, it is expected that much bluff and land for boulevards may be donated by owners, as in other cities. A parkway increases land values considerably, owing to the assurance of permanently attractive surroundings and a more agreeable means of communication. About Reservoir Park a striking example is presented of the increase in land values. At the time this park was established in 1889, lands were valued at two to three hundred dollars per acre, while the average now is seven hundred and fifty dollars per acre.

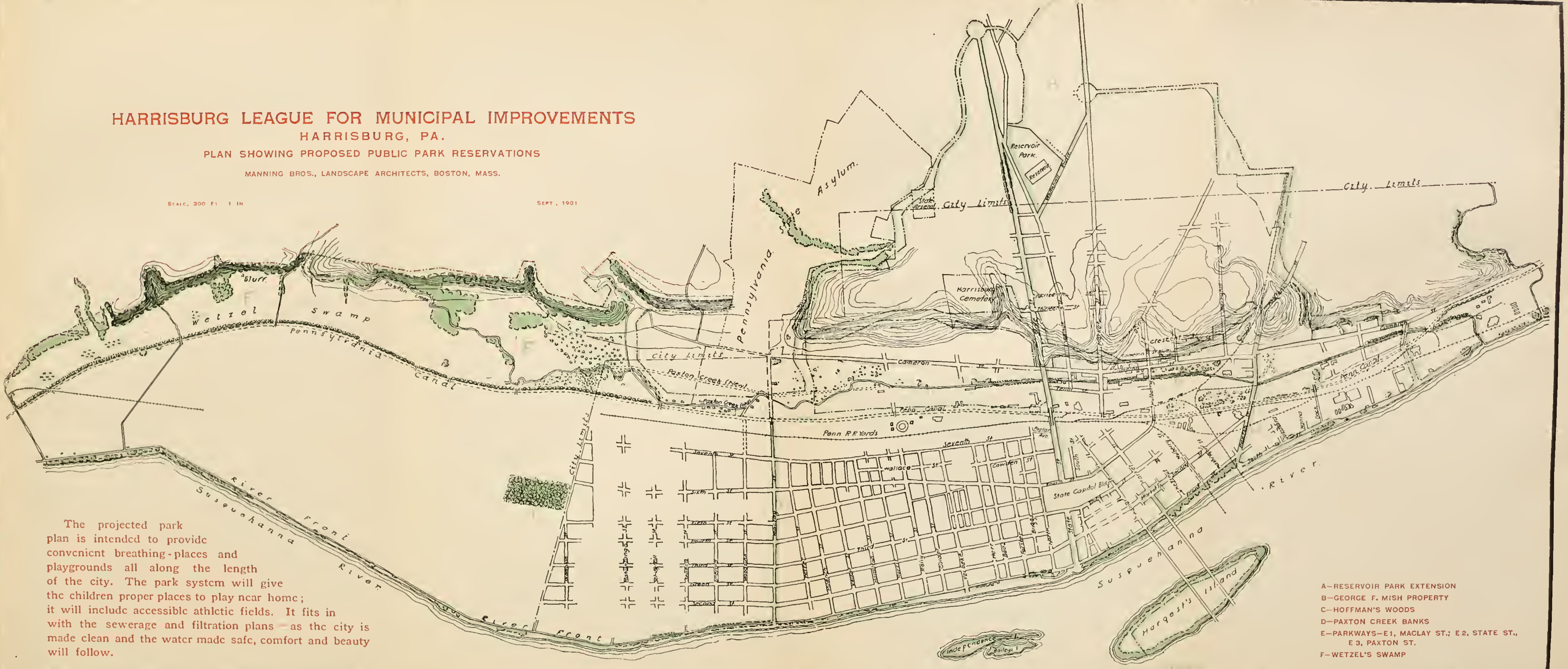
Should your city's finances prevent the inclusion of all the territory recommended, a portion of Wetzel's Swamp taking could be excluded, although it would be unfortunate to permit ground so thoroughly parklike at present to remain out of the control of your park authorities. It should be fully realized that in the bet-

HARRISBURG LEAGUE FOR MUNICIPAL IMPROVEMENTS
HARRISBURG, PA.
PLAN SHOWING PROPOSED PUBLIC PARK RESERVATIONS

MANNING BROS., LANDSCAPE ARCHITECTS, BOSTON, MASS.

SCALE, 300 FT 1 IN

SEPT., 1901



The projected park plan is intended to provide convenient breathing-places and playgrounds all along the length of the city. The park system will give the children proper places to play near home; it will include accessible athletic fields. It fits in with the sewerage and filtration plans — as the city is made clean and the water made safe, comfort and beauty will follow.

A—RESERVOIR PARK EXTENSION
B—GEORGE F. MISH PROPERTY
C—HOFFMAN'S WOODS
D—PAXTON CREEK BANKS
E—PARKWAYS—E 1, MACLAY ST.; E 2, STATE ST., E 3, PAXTON ST.
F—WETZEL'S SWAMP

ter part of this district park conditions now exist which would take many thousands of dollars and a generation of time to create, as other cities have discovered.

ACQUIREMENT OF LAND.

Act 257 of 1895 and its amendment 154 of 1901, allows cities to acquire land for park purposes outside of the city limits and requires the annexation of the same.

Act 239 of 1901 provides for the appointment by the Court of Common Pleas of five citizens, not officials or city employes, as trustees, to have authority over lands given to the city for park purposes.

Act 245 of 1895 provides that city school boards may permit the use of school grounds for recreation purposes and arrange for the care of the same. The act also permits the city to arrange with individuals or associations for the use of their property as park reservations, and make all necessary expenditures.

Act of 1901 authorizes the city council to appoint a commission for the direction of such public affairs.

GENERAL CITY IMPROVEMENTS.

I will close this report by referring very briefly to the work that individuals, firms and corporations are doing to make the city a more agreeable place to live in. The office buildings in the very heart of the great Bailey Rolling Mills, one covered with a luxuriant growth of vines and shaded by a vigorous tree, the other surrounded by flower beds and with groups of trees so disposed as to screen a great bare building from view, show that it is only necessary to extend planting operations of this character to relieve a great manufacturing plant from all its bareness.

Occasional individual trees in this establishment and elsewhere show how much can be hidden by a towering mass of foliage which is supported by a stem, only occupying but a few feet, and requiring but little care as compared with beds of expensive, tender plants that require yearly renewal. That it is not necessary to go to the expense of rich soil is made evident by the growth that you will find established in nothing but cinders.

Other instances might be given showing also the effect of individual effort in beautifying the city. If a simple but consistent plan was suggested, I believe many citizens would join cheerfully in the work by adorning with hardy trees and plants and turf their own premises. The educative effect of this effort cannot be overestimated.

A little encouragement to tenants will soon transform untidy back yards to pleasant garden spots, and a wholesome emulation between neighbors will soon turn the most forbidding parts of the city into spots of beauty.

The work that individuals are doing to make their homes as well as the city attractive, is well illustrated all over the city in the use of vines, window boxes and flowers. How important street trees are in making the city more attractive is well illustrated by the two sides of Broad street in looking from Front street to the river. It is this kind of civic improvement that should be encouraged by joining hands with such associations as the Civic Club, by aiding the formation of local improvement associations, and above all by enlisting the aid of the press.

WARREN H. MANNING.

September 16, 1901.

NOTE.—Mr. Manning's complete report includes exact figures as to acreage and cost.

REPORT ON STREET PAVING FOR HARRISBURG, PENNSYLVANIA.

For ease of traction, comfort and health, good roads and well paved streets, which will sustain the traffic and may easily be kept clean, are a necessary adjunct to good government. Combined with well constructed pavements, a good general appearance and finished look to the work should be obtained. Scarcely any other form of city government is as apt to impress the stranger visiting your city as the condition of your streets. This fact, together with the obtaining of the comfort, convenience and health of your own citizens, and the making of your city a more attractive place in which to live, should prove an incentive for more and better paved streets.

KINDS OF PAVEMENTS.

The selection of the kind of pavement to be used for the various streets must depend largely upon local conditions and upon the use to which such streets are likely to be put in the immediate future or during the life of the pavement.

I have looked over your streets carefully in company with your City Engineer and the Secretary of your League, and have noticed the nature of the traffic and present use of most of your principal streets. After considering these inspections and the class of pavements now laid, I would recommend the following kinds of pavements for use in your City and have endeavored to pick out typical streets upon which, in my judgment, such pavements could be laid to advantage:

Macadam pavement for Front street, or such purely residential streets as are not likely to ever become in any sense business streets, or upon which trolley lines do not now exist or are not likely to be laid. It might be advisable to lay a few blocks of this street in the centre of the city south of Walnut street with

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NOTE.—Mr. Sherrerd submits elaborate plans, cross-sections and specifications for the forms of paving recommended, which are contained in the complete report, available to those interested.

a more substantial pavement. From Walnut to North street, I would recommend macadam pavement twelve (12) inches deep, and from there north eight (8) inches macadam pavement. The curb line to be moved out from seven (7) to ten (10) feet on the east side where the same can be done and still give sufficient roadway. This space between the sidewalk line and the new curb line should be devoted to grass plots, as shown in one of the accompanying sketches.

Granite Block pavement on a sand foundation, or even on concrete in some cases where the sub-soil is naturally springy; for such streets as Race street (given as an example, though now paved with brick), where the traffic is very much congested and confined to a narrow space. Granite block is the most economical pavement in the long run for such locations. It also seems advisable, from the experience in other cities, that at some future date, should the traffic from factories, warehouses, etc., to the freight stations warrant it, that some through street running north and south should be paved with a granite block pavement to give one street which will be durable and at the same time serviceable in all kinds of weather.

Asphalt pavement on a concrete base for your business streets, such as Market Street, as now laid, and as may be selected for your semi-business and residential streets where the grade does not exceed five feet in one hundred. It is not, however, well to lay asphalt on streets that have an exceptionally light traffic, as this pavement needs a moderate amount of traffic to insure its life. It has also been found expedient not to lay too many consecutively parallel streets with asphalt on account of its slippery condition for days at a time during the winter.

Brick pavement on a concrete foundation for such streets as Mulberry and State streets, at least for the steep parts of such streets, as well as for the purely residential streets and those of a semi-business nature.

In many cities the selection of either brick or asphalt for reasonably level streets is generally one of local choice, and the combination of two kinds of pavement on the same street is often found. That is, the steeper parts being paved with brick, generally selecting a brick with a rounded edge for the portion of the street having the heavy grade. A combination of these two pavements might prove of advantage for such streets as Thirteenth and Derry streets. These two streets will always be more or less thoroughfares and business streets, and I would not advise the use of macadam on them for this reason and for the further reason that it is not well to use macadam where there are street car tracks.

Where streets like the above exist which have already been more or less macadamized, it has sometimes been of advantage to use the macadam existing on the street in the preparation of the foundation for a more improved pavement. A good foundation for either brick or asphalt may be made by taking up the old macadam, carefully cleaning it, relaying on a new sub-grade, rolling it thoroughly and washing in sand until all the interstices are full. Such foundation is slightly cheaper than concrete, but if the pavement is to be more or less disturbed by cutting for house services, it is always more difficult to replace the foundation satisfactorily than where concrete is used.

GENERAL CROSS-SECTION FOR PAVEMENTS.

In general, the slope of the cross section for granite, asphalt and brick pavements should be one foot in forty or fifty feet. That is, a street forty feet between curbs should show a six-inch gutter on each side, with the centre of the street level with the top of the curbs, and the distance at the quarters measured down from a line between the top of the curbs should be one-quarter of the depth of the gutter or one and one-half inches. This gives a comparatively level space in the center of the street for traffic, and a fall of four and one-half inches from one-quarter roadway into the gutter. For residential streets, many cities have adopted narrowing the road when the streets are paved, and a thirty-foot roadway is found sufficient even for streets sixty feet in width former roadways have been thirty-six to forty feet. I believe that in many cases, particularly where street car tracks are not likely to be laid, that even twenty-eight feet between curbs will be found sufficient width. This narrowing of the roadway will not only reduce the cost of pavements per running foot, but will allow the new curbs to be set on uniform lines without interfering with trees and other permanent fixtures along the sidewalk, and will at the same time allow space for grass plots in front of each lot, which if systematically cared for materially enhances the appearance of the street. On hill streets, or as the grade increases above three feet in one hundred, the cross section of the street can be considerably flattened to advantage by dropping the centre of the street from one inch to two inches below the top of the curb for a forty-foot street.

For macadam pavement, the cross section should be somewhat steeper, particularly where much water is carried in the gutters, and also on steep grades where the water should be confined to the gutters as much as possible. Gutters of stone or brick should be laid in connection with all macadam pavements, as the wash of the water is particularly injurious to this class of pavement.

When a brick gutter is used in connection with asphalt pavements it should extend about three and one-half feet from the curb, and should be composed of regular street paving bricks laid to the same cross section as for the asphalt pavement with the joints carefully grouted with Portland cement.,

STREET-CAR TRACK CONSTRUCTION.

The difficulty of maintaining pavements adjoining street-car tracks has been a source of constant trouble in all cities. The traffic constantly following the rail and giving undue wear to the longitudinal joint between the rail and the pavement, combined with a movement of the track due to a yielding substructure and the heavy electric cars which are now in use, all tend to require much care in the method of laying tracks and pavements adjoining them. Many cities have adopted the laying of granite blocks and sometimes brick in a header and toothing course along the rail in conjunction with asphalt pavements, but these blocks or bricks often become displaced due to the movement of the rail, or the line of wear is moved out to the joint between the pavement and the blocks or bricks. The first requisite to obtain good results in laying pavements along street car tracks is to have substantial and firm track construction, which will be rigid and prevent the breaking of the bond between the pavement and the rail. When the work is thus constructed, I would recommend that the pavement adjoining the track be carried directly to the rail both inside and outside the track. I have shown in the sketches a method of laying the street car tracks on a beam of concrete, using iron ties and iron tie rods, these being also laid in concrete. This is practically the construction used by the Harrisburg Traction Company on Market street, and I understand is approved by them.

In connection with street-car tracks it is also advisable to provide a catch basin for surface water between the rails of each track where a pocket or a change from descending to ascending grade occurs in the street. Such catch basin to be connected with the street catch basin or sewer and covered with an iron grating extending from rail to rail and set on a level with the tread of the rail and slightly below the pavement grade.

DISCUSSION OF THE SEVERAL KINDS OF PAVEMENTS RECOMMENDED.

As has been before stated, the ideal pavement for street use has not yet been found, and there are a number of objections to each of the several kinds of pavements heretofore recommended. Some of these objections to a greater or less degree may be obviated either in the construction or the care of the streets. Macadam pavements are short lived at the best and need constant and systematic repairs. These repairs should be made practically in the same way in which the pavement was constructed, the old surface being gone over carefully with a pick to allow the new stones to bind in with the old, and finer stones should be used in making the top, all being rolled together as the work proceeds. Local limestone can be used to advantage for the bottom courses, but the top dressing should be of some hard material, and for the neighborhood of Harrisburg, I would suggest that some of the local hard stones be tried for the top dressing.

Granite block, though the most durable pavement, is very objectionable on account of its rough surface and the noise resulting from its use. It is also difficult to keep this pavement clean. Its use should be confined exclusively to business or manufacturing districts, or where exceptionally heavy traffic is confined to narrow limits.

Asphalt pavement, when properly laid, is no doubt the most satisfactory pavement for city streets. It should also be kept scrupulously clean. The street filth being ground to fine powder upon its surface is particularly objectionable and penetrates into all crevices. Constant sprinkling and the use of much water on asphalt streets not only affects the life of the pavement, but forms a sticky paste which is very objectionable. Many cities have found it advantageous to thoroughly flush asphalt streets at night, or systematically care for them by the constant attention of a man to a section, the length of a section depending upon the amount of traffic.

For well-laid pavements the annual cost for maintenance and repairs, after the end of the guaranteed period, will be much less for brick than for asphalt pavements. This fact should be considered in comparing the two pavements, particularly when the maintenance becomes an annual city charge and the property owner cannot be assessed for a second pavement, as I understand is the case in Harrisburg.

ASSESSMENTS FOR PAVING.

The laws regarding the assessments for public improvements vary greatly. Where extended improvements are contemplated, it has been found very satisfactory to assess an arbitrary percentage of the work upon the City at large. This percentage varying from fifty per cent. of the entire cost down to an amount practically equivalent to the cost of the street intersections. Pavements while being of specific benefit to the contiguous property, are no doubt a great advantage to the City taken as a whole. These are hardly questions of engineering and the percentage of the assessments which should be borne by the City, should, I think, be carefully considered by your committee. I understand that the present practice in your City in regard to this matter is to place practically the entire assessment upon the abutting property owners, allowing payments to be made in ten annual instalments, upon which 6 per cent. interest is charged, the contractor being paid in the bonds against improvement.

It has been found of advantage in a number of cities to limit the instalments to three or five years, and to have a general paving fund either from a bond issue or from a fixed amount in the general tax levy from which the contractor may be paid after the completion of the work. This fund is eventually used for paying the city's portion of the work, all payments of instalments being credited to the fund, which is thus replenished from year to year and the amount of paving ordered each year is limited to the amount of money available in the fund. Such method is generally popular and is an inducement for property owners to petition for pavements. It also insures the contractor of immediate payment and therefore results in low prices.

Before streets are paved it goes without saying that all of the underground constructions should be placed in a first-class condition and the several services for sewer, water and gas connections should be laid, even to vacant lots, to prevent the tearing up of the pavement. In actual practice this is seldom done and often would result in having a lot of services in the street which would never be used. Some safeguard, however, should be provided to reduce to a minimum the number of openings made in new pavements.

Respectfully yours,

M. R. SHERRERD,
Consulting Engineer.

TAXATION OF THIRD-CLASS CITIES IN PENNSYLVANIA

HARRISBURG ONE OF THE LOWEST

There are only two cities with a ***lower*** millage-rate for city purposes; Allentown and Easton. One city, York, has the same rate. The cities with about the same population all have much larger rates, and only seven cities in the United States have a lower rate, for strictly city purposes. Even on the ***total*** tax (City, School and County), seven third-class cities in this list pay much more than Harrisburg. One city (Altoona) pays 17 mills, the same as we do, York about the same, and only three cities (Reading, Allentown, Easton) pay less. Johnstown was not reported.

	POPULATION	TAX RATE, IN MILLS.			
	1900.	*City.*	*School.*	*County.*	*Total.*
Reading	78,961	8	4	2⅓	14½
Erie	52,733	13½	8	2½	24
Wilkesbarre	51,721	11	6⅓	7½	25
Harrisburg	50,167	**7**	**6**	**4**	**17**
Lancaster	41,459	9	5	3½	17½
Altoona	38,973	7½	5½	4	17
Johnstown	35,936				
Allentown	35,416	3.8	5	2.2	11
McKeesport	34,227	9¾	7⅓	3	20¼
Chester	33,988	10	6	3½	19½
York	33,708	7	5	4¾	16¾
Williamsport	28,757	14.6	7	5	26.6
Newcastle	28,339	8½	7	3½	19
Easton	25,238	6½	6	2.6	15.1

The relation of assessment to valuation in all these cities above 25,000 is given by the various City Controllers as between 60 per cent. and 75 per cent., save Wilkesbarre, which is taxed at 40 per cent. of the full valuation.

All these figures were obtained, by direct request, from the City Controllers, since January 1, 1902.

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OBJECTS OF THE IMPROVEMENTS

THE vote of the citizens of Harrisburg on February 18, 1902, will be upon an increase of the city's debt by an ultimate amount of not over $1,090,000, to be expended under the direction of three unsalaried citizens as a Board of Public Works, for—

1. **The Abatement of the Paxton Creek Nuisance.** (It is proposed to deepen the channel to prevent floods and to construct an intercepting sewer to take the drainage of half the city, thus making Paxton Creek clean and safe.)
2. **The Correction of the Defective and Dangerous Sewers of the City.** (This means the removal of all present difficulties and dangers to public health.)
3. **The Filtration of the Water Supply.** (This will remove disease germs as well as culm and clay.)
4. **The Building of a low Dam to keep the Susquehanna River about four feet above low water mark.** (This will cover the mouths of the sewers, and prevent malaria and mosquitoes.)
5. **The Creation of a Park System for the City.** (This means the extension of Reservoir Park and the opening of other parks accessible to all the people without necessarily riding on the trolley cars.)
6. **The Provision of a Fund for Paving Street Intersections.** (When property owners petition for pavements, Councils can then provide for the intersections.)